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ABSTRACT

Evaluation of Project Learning Tree (PLT) involved a survey of PLT's utilization in British Columbia and the field experiment. The survey included participant observers' reports on PLT teacher training workshops, a mail survey of workshop participants, and telephone interviews with selected respondents. Two treatment conditions were effected at grades 3, 5, and 7 involving a minimum of two school districts. Both cognitive (achievement) and affective (attitude) dimensions were assessed for potential impact of the instructional intervention. The field experiment involved the development of instructional units for grades 3, 5, and 7 by classroom teachers identified through the survey as "high" users of PLT; participation in 3-day workshops at the University of British Columbia; the evaluation team and PLT facilitator's revision of the units prepared at the workshops; development of specifications and preparation of tests to assess the units' cognitive and affective components; identification of field sites and teacher recruitment; attendance of participating teachers at training workshops offered by the PLT facilitator and evaluation team; and monitoring of classroom execution and testing by the evaluation team. Overall, teacher response to the materials was positive. Delivery of instruction appeared to be most consistent at grade 5 and most idiosyncratic at grade 7. (NQA)

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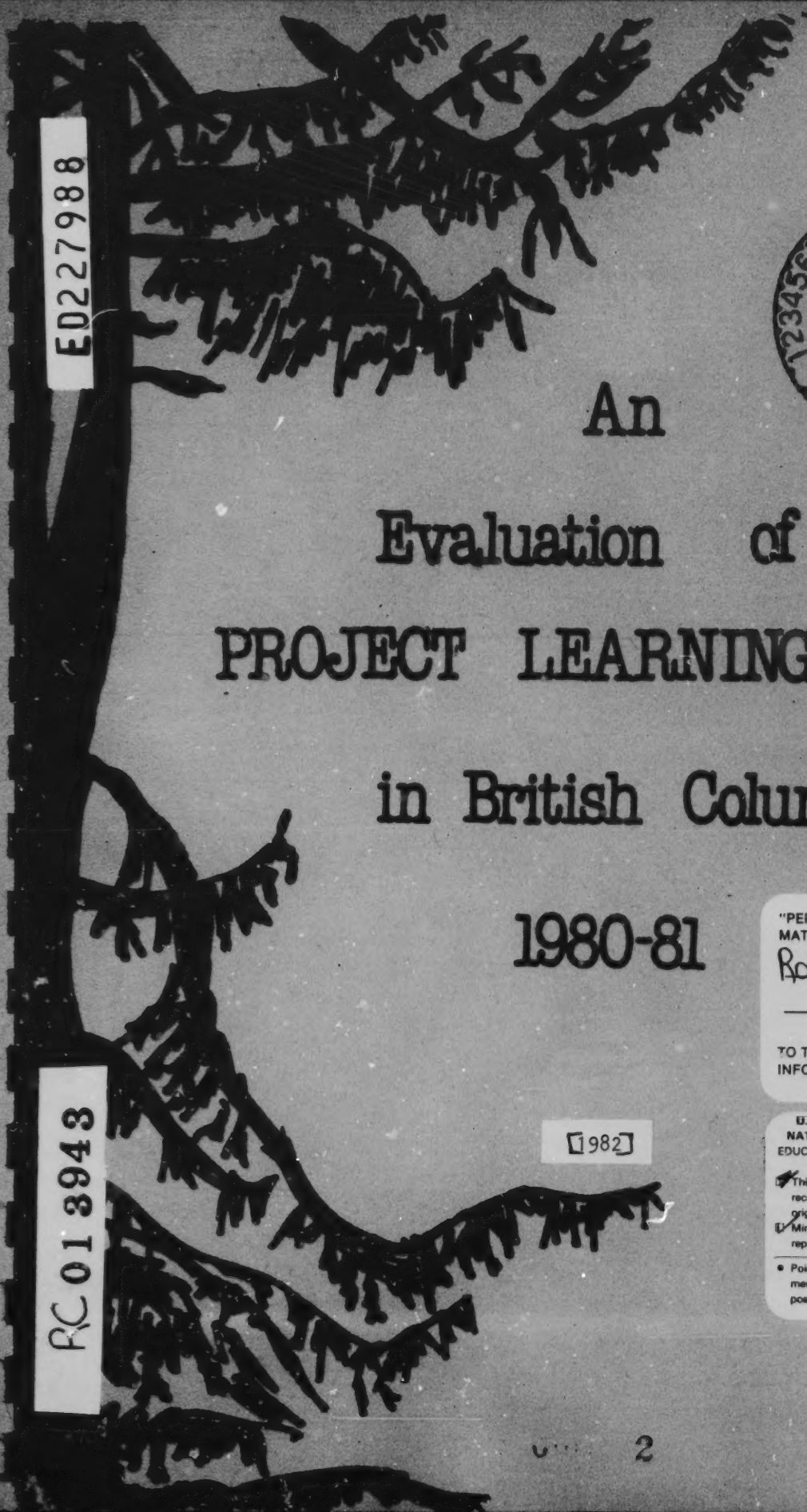

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RC013943

An Evaluation of Project Learning Tree in British Columbia, 1980-1981.

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Executive Summary

The British Columbia Evaluation of Project Learning Tree (P.L.T.) occurred in two phases: Phase I was a survey of the utilization of Project Learning Tree in B.C., and included participant observers' reports on Project Learning Tree teacher training workshops, a saturation mail survey of workshop participants and telephone interviews with selected respondents. Phase I yielded lists of B.C. educators interested in participating in Project Learning Tree curriculum development and field experiments with the resulting units. (The Phase I report appears as Appendix G.)

Results of the Phase I Evaluation of Project Learning Tree in British Columbia indicated that while teachers were enthusiastic about the Project Learning Tree materials, classroom use was idiosyncratic. In order to obtain data to assess the effects of the materials, then, it was necessary to induce systematic use of specific lessons at given grade levels to permit comparisons.

Evaluation Plan

The evaluation plan, presented as part of the Phase I report, called for two treatment conditions to be effected at each of three grade levels involving a minimum of two sites (school districts). It also designated that both cognitive (achievement) and affective (attitude) dimensions be assessed for potential impact of the instructional intervention.

Design of the field experiment, using a wait-list control, is diagrammed below:

	Time 1		Time 2		Time 3
Group A	O_1	X	O_3		
Group B	O_2		O_4	X	O_5

Where X = an instructional period of six weeks duration

O_1, O_2 : Affective measures

O_3, O_4 : Affective and achievement measures

O_5 : Achievement measures

Briefly, teachers of classes at neighbouring schools would be recruited, and all students tested at time 1. Group "A" classes would then receive instruction using the curriculum unit developed by the project for each grade level; following this instructional period all students would again be tested. After the second testing session, Treatment B students (wait list controls) would receive instruction, after which they would complete a final testing session.

Execution of the field experiment was completed in a series of steps:

1. Instructional units for each of grades 3, 5 and 7 were developed by classroom teachers identified through the Phase I survey as "high" users of Project Learning Tree. Ten teachers, along with four resource coordinators, participated in these three-day workshops at the Universtiy of British Columbia. (See Appendix A for details.)

2. Units prepared at the workshops were revised and edited by the evaluation team and the Project Learning Tree facilitator.

3. At the same time, specifications were developed and tests prepared to assess both cognitive and affective components of the units.

4. Field sites were identified and teachers recruited through contacts established in Phase I.

5. Participating teachers attended training workshops offered by the Project Learning Tree facilitator and the evaluation team.

6. Classroom execution and testing were monitored by visits from members of the evaluation team.

Six to seven week units, requiring ten to twelve hours of instruction, were developed for each of the designated grade levels. The units were designed to be compatible with the B.C. Core Curriculum, practicable for teachers with no special knowledge or equipment, free of geographic or seasonal constraints, and based on lessons of demonstrated appeal to teachers and students. The grade three unit, entitled "Trees Please", focussed on development of awareness and incorporated nine lessons from the elementary Project Learning Tree manual along with three "extensions" of this material. The grade five unit was cognitively oriented, focusing on natural succession. Entitled "The Study of a Forest", this unit incorporated all or part of thirteen of the Project Learning Tree elementary lessons. For grade seven, the teachers chose a set of lessons entitled "The Use of Our Forest -- Can We Decide?", which dealth with responsible use of natural resources. Materials were a combination of

Project Learning Tree elementary and secondary lessons, many of them structured for two or three class periods. Both instructional units and teachers' guides were prepared for each of the three grade levels. (See Appendix B for copies.)

Test Development

Responsibility for the development of cognitive and affective outcome measures was shared by four members of the evaluation team, with consultation and assistance provided by the Project Learning Tree facilitator. (See Appendix C for copies of all tests.)

Objectives-referenced achievement tests were developed for each grade level, based on behavioural objectives identified for each lesson. Item formats were selected for their compatability with objectives and their appropriateness for the grade level in question. Achievement tests at all levels contained both selection and short-answer questions, and were composed primarily of items designed to elicit evidence of comprehension, application and analysis. In order to enhance motivation, two characters -- Sherlock Hemlock and Arlene Arbutus, tree detectives -- were developed for the grade three test. These characters are introduced on the first page, and the child is asked to enter the role of assisting them in their detective work through a series of diverse activities. Both the grade three and five tests rely heavily on graphic and pictoral material. An artist was contracted to provide drawings to specifications and to develop a theme character -- a lumberjack in various poses who appears throughout all the tests.

In developing an affective measure for grades three and five, a number of decisions were reached:

-- a single test would be designed for both grades,

-- the measure should focus on general attitudes towards trees and forests,

-- verbal skill requirements should be minimized for both stimulus and response, and

-- administration time should not exceed 15 minutes.

The use of pictoral stimuli had been suggested during the unit development workshops. The format selected to accommodate the use of such stimuli in a practicable format was a set of 35 mm slides, accompanied by individual response scales. A list of stimulus-subjects was developed, some expected to elicit positive responses -- for example, a forester tending young trees -- and some to produce negative response -- for example, tree trunks mutilated by carving. The Project Learning Tree facilitators provided slides, taken to specifications, and they arranged borrowing privileges with the B.C. Forest Research Service, which maintains an extensive file of slides and photographs. A set of 160 potential slides was reduced to 40 in a series of trials and meetings. At the same time, trials of a variety of response scales resulted in selection of a five-option "happy face - sad face" scale. Analysis of pilot test results indicated that two discrete scales could be identified; the first consisted of seven stimuli related to the logging industry, and the second of 23 stimuli which related more generally to trees or forests.

The requirements of an affective measure to accompany the grade seven unit posed some unique problems. The grade seven unit was designed to moderate extreme positions on development of forest resources and to foster an awareness of responsible resource use. The instrument developed consisted of a series of 'scenarios' about resource use problems. Each scenario was accompanied by four possible solutions, selected to represent "extremist conservation", "responsible recreation use", "responsible economic development", and "irresponsible economic development". A variety of response formats were considered; consideration of pilot test results led to adoption of a four-point scale anchored with "Strongly agree", "Agree", "Disagree", and "Strongly disagree". The instrument yields five scores; one representing extent of support for each of the positions offered, and a "total" score obtained by combining and weighting the scenarios and solutions.

Identifying Field Sites

Response to the Phase I survey had indicated that the most likely "prime sites" for a field experiment were the Lower Mainland/Fraser Valley area, and Vancouver Island. Local coordinators were identified for three districts: Coquitlam and Surrey (suburban areas in the Fraser Valley), and Nanaimo on Vancouver Island. Within each district, a minimum of four classrooms at each grade level was recruited: two of these were designated Treatment A, and two Treatment B (wait list). The entire sample included over 1000 students. Training workshops were designed and presented as a cooperative activity of the Project Learning Tree facilitator and the evaluation team. The Project Learning Tree facilitator provided a "condensed" version of Project Learning Tree workshops; the evaluation team described the field experiment and demonstrated administration of the tests. Teachers at each grade level examined and discussed their respective units.

In the Fraser Valley area, a number of site visits were made at the outset of the experiment to facilitate delivery of the affective tests. Further visits -- along with personal delivery of time 2 testing materials -- occurred mid-project, and included observation in a number of classrooms. Teacher questionnaires were also used to solicit both delivery and evaluative information.

Data Analyses

Results of the student tests were analyzed in three steps: first, item analyses were performed to examine psychometric characteristics of the instruments and to examine specific item responses; next, descriptive analyses were performed to provide estimates of within-group performance, and of associations among measures used. Finally, analyses of variance were implemented to assess changes attributable to instruction with the Project Learning Tree unit. It should be noted that a different pattern of tests was administered at each of the three testing periods, as follows:

Treatment	Time 1	Time 2	Time 3
A	affective	affective achievement	
B	affective	affective achievement	achievement

Program Implementation

Overall, teacher response to the materials was positive. Virtually all participating teachers indicated intentions to use the materials in the future, although some expressed frustration with adhering to the experimental timetable. Delivery of instruction appeared to be most consistent at grade five, and most idiosyncratic at grade seven. The more structured school curricula for grade 7 -- the final year of elementary school in B.C. -- with heavy time demands from many areas, along with time demands from extra-curricular

activities, caused serious problems in completion of the unit within the designated time period. In fact, we would suggest that unless Project Learning Tree is presented as part of the science or social studies curricula, it is unlikely to see much use in grade seven classrooms except where the teacher is strongly committed to outdoor education.

In a field experiment, Project Learning Tree's principal strength became a limitation -- the flexibility, even within a given lesson, which makes it so appealing to teachers, prompted anomalies in delivery which were difficult to detect. Caution is suggested in interpreting the results.

Results

Repeated measures analyses of variance performed on the Treatment B pre- and posttest results, controlling for district differences, indicated treatment effects for achievement at each of the three grade levels for the total sample and for each district, although the magnitude of the effect varies from district to district. These results were confirmed by analyses of the Treatment A posttest versus Treatment B pretest results -- these tests were both administered at time 2.

Examination of item level results for grade three indicated high entering scores on a number of items -- students entered the program exhibiting prior mastery of a number of competencies which the unit was designed to develop. Consequently, different patterns of gains are observed for different objectives. Student performance showed strongest gains for items measuring objectives developed in lessons 1, "The Touchy-Feely Box", and 6, "Tree Cookies"; and, to a lesser extent, lesson 4, "How Big is Your Tree?"

Grade five item-level results indicated both a greater magnitude of overall gains than in grade three, and a more consistent pattern of gains over lessons and objectives; student scores showed strong gains on virtually every item.

The grade seven pattern of results was less consistent, with clear differences in the magnitude of gains among items designed

to measure different objectives. Students displayed strongest posttest competence on items dealing with the consequences of resource use, the value of living trees, and the identification of renewable versus nonrenewable resources.

Results of the affective tests at grades three and five indicated no change in attitude toward logging at either grade, and a significant treatment effect for attitude towards trees (controlling for district) only at grade five. At both grades five and three, however, a significant interaction for treatment-by-district appeared: in one district, attitudes changed during treatment; in others, they didn't. At grade three, interpretation of this interaction is obscured by response bias apparently induced in one class.

Five affective scores were considered at grade seven, representing extent of agreement with each of four role positions, and an overall "conservationist" score. For all administrations of the test, students indicated the strongest support for "Responsible recreational use" and the strongest disagreement with "Irresponsible economic use". No significant treatment effects appeared for either position, or for "Extreme conservation", the position which enjoyed the second highest degree of support. At posttesting, however, support for "Responsible development" had increased, nearly equalling support for "Extreme conservation". While rankings of the four positions were stable, the single significant change in attitude

was toward the "Responsible development" position. Students indicated a significant greater degree of support for this position following exposure to the unit. No effect appeared for total score.

Conclusions

The following conclusions are based on results of the Phase I survey, the Phase II field experiment, and discussion with Project Learning Tree participants and facilitators:

1. Under conditions of effective implementation -- where "lessons" are organized into cohesive curriculum sequences and teachers are able to deliver such curricula during a routine instructional time block -- PLT yields significant achievement gains at all grade levels examined.

2. Under conditions of effective implementation, the grade seven PLT unit yields significant changes -- increasingly positive -- in attitudes toward responsible development of natural resources. Attitude shifts in grades 3 and 5 are more ambiguous, but it appears that learning about the nature and uses of "trees" (these units were aimed primarily at cognitive abilities) may lead to a more negative reaction to trees/forests being harmed, while no changes occur in attitudes toward logging activities.

3. While the flexibility of PLT offers a number of advantages, "packaged" units of instruction tied to local needs are more likely to be extensively used in the primary and early intermediate grades than individual lessons.

4. Given the curricular and extra-curricular demands on grade seven instructional time in educational systems like British Columbia, PLT is unlikely to see extensive use at that grade level unless it appears as an institutionalized curriculum segment.

5. Teachers with no previous training or experience in forestry or outdoor education find the manuals -- both the original and the experimental forms -- deficient in background information, and they are unable to spend time in research to acquire this background.

6. Lack of classroom resource materials -- such as wood samples, tree cookies, magnifying glasses, etc. -- appears to be a major barrier to use of many of the lessons. In spite of the direction and assistance offered by the PLT facilitators, many teachers are either unable to take advantage of sources of these materials or unaware of their existence. It may be that packages of resource materials delivered directly to schools or provided at workshops would do more to increase use of PLT than any other tactic.

Specific recommendations related to these conclusions are presented in the final section of this report and deal with:

* materials (p. 114)
* workshops (p. 116)
* local development (p. 117)
* curriculum adoption (p. 119)
* further research (p. 120)

Background and Methods

By Jamie D.

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BACKGROUND AND INTRODUCTION

The Canadian Forestry Association and the Weyerhauser Foundation commissioned an assessment of the efficacy of Project Learning Tree (PLT) in British Columbia. The proposal submitted by the evaluation team, and subsequently accepted, called for two related phases: in Phase I, a saturation mail survey of all Project Learning Tree workshop participants was undertaken to:

1. examine participants' perceptions of the workshops and the materials,
2. enable estimation of current use patterns in British Columbia, and
3. identify classroom teachers and "prime sites" for the execution of Phase II -- a field experiment.

Results of the Phase I activities[1] indicated that while teachers were enthusiastic about both the workshops and the Project Learning Tree manuals, use of the materials was so idiosyncratic as to prohibit the use of naturally-occurring settings for a field experiment. Little systematic use of the materials was evident, although a large number of the teachers reported using some of the lessons in a variety of curriculum contexts. Telephone interviews with selected respondents confirmed strong interest in Project Learning Tree, and indicated that a sufficient number of teachers and district-level coordinators could be assembled to enable experimental trials.

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[1] See Appendix G in this document for the Phase I final report.

On the basis of these findings, it was recommended that systematic units of materials be assembled for three grade levels by teachers identified in Phase I, and that the effectiveness of these units then be evaluated through a controlled field experiment executed at two or three "prime sites".

The evaluation plan presented called for two treatment conditions -- experimental and wait-list control -- to be effected at each of grades three, five and seven in a minimum of two sites. The plan also called for assessment of experimental effects along both cognitive and affective dimensions. The design is diagrammed below:

	Time 1		Time 2		Time 3
Group A	O_1	X	O_3		
Group B	O_2		O_4	X	O_5

(X = an instructional period of six weeks duration)

O_1, O_2 : Affective measures

O_3, O_4 : Affective and achievement measures

O_5 : Achievement measures

Teachers of classes at neighbouring schools were to be recruited: those at one school assigned to Treatment A -- experimental -- those at the other school to Treatment B -- wait-list control. At time 1, students in both treatment groups would complete tests designed to measure attitude. Following this testing, the Treatment A classes would receive a six-week unit of Project Learning Tree lessons. At time 2, students in both treatments would receive both achievement and attitude tests. The achievement tests given at this time would

serve as a post instruction measure for the Treatment A students, and as a pretreatment measure for Treatment B students. The attitude tests would enable pre- to post-instruction comparisons for Treatment A, while allowing estimation of reactivity -- changes due to simple repetition of a test -- by comparisons between the time 1 and time 2 results of the test, within an uninstructed comparison group. Treatment B students would receive instruction between times 2 and 3, and receive a second administration -- a posttest -- of the achievement test at time 3. This design would be replicated at three grade levels -- three, five and seven -- at three sites. This design was accepted by the evaluation advisory group, and activities related to the Phase II field experiment began in September 1979.

A number of related activities were required for the execution of the experiment, including:

1. Instructional units for each of grades 3, 5 and 7 were developed by classroom teachers identified through the Phase I survey as "high" users of PLT. Ten teachers, along with four resource coordinators, participated in these three-day workshops at the University of British Columbia.

2. Units prepared at the workshops were revised and edited by the evaluation team and the PLT facilitator.

3. At the same time, specifications were developed and tests prepared to assess both cognitive and affective components of the units.

4. Field sites were identified and teachers recruited through contacts established in Phase I.

5. Participating teachers attended training workshops offered by the PLT facilitator and the evaluation team.

6. Classroom execution and testing were monitored by visits from members of the evaluation team.

7. Data from test administrations were analyzed to permit identification of changes due to exposure to PLT units.

DEVELOPMENT OF INSTRUCTIONAL UNITS

In order to conduct a controlled field evaluation of the Project Learning Tree materials, it was necessary, as noted above, to define "units" of material selected from the array of lessons offered in the manuals. If the "units" were to be viable as six to eight week segments of instruction in the B.C. public schools, it was considered essential that they be assembled by field practitioners who had evidenced both extensive experience with and a strong interest in the Project Learning Tree materials.

Recruitment of Participants

"Unit development" workshops were held at the University of British Columbia on October 11, 12 and 13, 1979. Ten teachers, respondents to the Phase I "saturation" survey as well as to telephone interviews in the Spring and Summer of 1978, were invited to participate. They were released from their classroom duties through arrangement with their school districts. Participants were selected by the evaluation team, in consultation with the Project Learning Tree facilitator. Criteria for selection included:

- reported classroom use of PLT materials,
- expressed interest in development activities,
- geographic location,
- grade level taught, and
- availability.

As all participants had been identified through the saturation survey of teachers who had attended workshops, all teachers had attended at least one Project Learning Tree workshop. A major criterion for selection was the somewhat subjective estimation of the degree of enthusiasm expressed in telephone interviews. Only those teachers who displayed strong interest in the Project Learning Tree concepts and in development of locally tailored "units" were considered.

In order to tap as wide a range of experience as possible, the evaluation team sought representation from as many school districts as possible. In fact, only one district (Nanaimo) was represented by more than one teacher. It was considered desirable to recruit teachers from various geographic areas of the province, although practical constraints dictated that participants be drawn from areas with relatively easy access to Vancouver. Because the Vancouver Island region was considered a prime site for the eventual field experiment -- due to the strong interest expressed by Vancouver Island teachers, and the heavy reliance of northern Vancouver Island on the forest industry -- the evaluation team attempted to recruit one Vancouver Island teacher at each of the grade levels of interest.

A final consideration in selecting teachers for the unit development workshops was familiarity with students and B.C. curricula at the grade level of interest. Thus, all teachers invited to work on definition of the grade seven unit had extensive experience working within the prescribed B.C. curriculum in Grade

seven classrooms. Four teachers were selected to work on the Grade three unit; three teachers were selected for each of grades five and seven.

The ten teachers who eventually comprised the unit development teams represented nine school districts in four broad geographical areas of the province (see Appendix A for a list of participants and school districts). Seven of the teachers were female; three were male. Years of teaching experience ranged from 0.5 to 35, with a median of 9.

Arrangements were made with local school districts to release teachers from their regular duties for the duration of the workshops. Travel expenses and accommodation in Vancouver were provided for the five teachers who resided outside of the Lower Mainland area.

Workshop Activities

The first session of the workshop was devoted to an overview of the task, provided by the evaluation team, and suggested strategies, offered by the Project Learning Tree facilitator. A summary of Phase I of the evaluation was given, as well as an outline of Phase II. The task was defined as the production of a 6-7 week unit of instruction at each of Grades 3, 5 and 7. Instructional time on task was estimated at 10 to 12 hours. The units were to be:

- compatible with the B.C. Ministry of Education's Core Curriculum,
- practicable for classroom teachers with no special knowledge or equipment,
- equally suitable for students in diverse areas of the province,
- coherent within a theme,
- not tied to seasonal constraints, and
- based on lessons of demonstrated appeal to teachers and students.

Teachers were encouraged to begin by reviewing the range of lessons suitable for the grade level of interest, and "brainstorming" to identify possible themes. The Project Learning Tree facilitator offered examples of naturally occurring themes, and the way in which appropriate lessons might be identified and sequenced. The introduction -- offered as a sample session -- extended until lunch of the first day.

For the afternoon session, a separate room along with resource materials and a resource person was provided for each of the grade level teams. The three resource people -- instructors in the Faculty of Education at the University of British Columbia -- functioned primarily as chairmen, attempting to focus discussion and to ensure cooperative development of the units. They did not participate directly in the selection of themes or lessons. Additionally, the Project Learning Tree facilitator was on site to provide guidance or clarification as requested.

The groups were extremely task-oriented and well prepared for the workshop. By the end of the afternoon session, each had identified a theme, selected the lessons to be included, identified major alterations and additions to be effected, and roughed-out a sequence. One group had begun building a teachers' guide, and had outlined two "new" lessons felt to be compatible with the Project Learning Tree materials and necessary for the development of the theme. The facility with which these activities proceeded appeared to be due to the convergence within each group regarding theme and lesson selection -- an indication of the experience, preparation, and enthusiasm of the teachers.

Outline of the Units

The grade three teachers chose to define a unit entitled "Trees Please" which focussed on the development of awareness of trees, and selected the following sequence of lessons:

1. The "Touchy-Feely" Box (PLT #11, Elem.)
2. Tree Assembly (new material)
3. Adopt-A-Tree(PLT #1, Elem.)
4. How Big is Your Tree? (PLT #36, Elem.)
5. Sherlock Hemlock (new material)
6. Tree Cookies (PLT #37, Elem.)
7. Plant Personification (PLT #17, Elem.)
8. Tree Shapes, Natural and Unnatural (PLT #10, Elem.)
9. Build Your Favourite Tree (new material)
10. Expanding Sensory Perception (PLT #7, Elem.)
11. Long Range - Short Range (PLT #47, Elem.)
12. How to Keep a Tree Happy (PLT #86, Elem.)

The complete sequence of lessons is included as part of Appendix B. Teachers noted that the three "new" lessons were, in fact, extensions of the Project Learning Tree lesson they followed in the sequence.

The Grade five unit "The Story of a Forest", was primarily oriented to cognitive abilities and its content focus was 'natural succession'. The sequence of lessons selected was:

1. What's in Soil/Sand, Silt and Clay? (PLD #54/80, Elem.)
2. Growth Graph (PLT #51, Elem.)
3. Tree Cookies (PLT #37, Elem.)
4. Sunlight and Shades of Green (PLT #51, Elem.)
5. Succession on the School Grounds (PLT #63, Elem.)
6. The Closer You Look (PLT #5, Elem.)
7. Leaf Prints (PLT #9, Elem.)
8. Forest Consequences (PLT #89, Elem.)
9. The Second Little Pig (PLT #19, Elem.)
10. Maple Mallets and Ash Bats (PLT #22, Elem.)
11. Paper in the Classroom/Classroom Conservation (PLT #84, Elem.)
12. Outdoor Manners Colouring Book (PLT #86, Elem.)

The complete text of these lessons is included in Appendix B.

At the Grade seven level, the teachers chose a set of lessons focussing on responsible resource use, and titled it "The Use of Our Forest - Can We Decide?" The lessons which comprised this unit were:

1. What is a Forest? (PLT #53, Sec.)
2. Forest Products All Around Us (PLT #9, Sec.)
3. Classifying Forest Products for Compatability (PLT #37, Sec.)
4. With or Without (PLT #24, Elem.)
5. Lovin' It to Death (PLT #80, Sec.)
6. The Second Little Pig - His House of Wood (PLT #19, Elem.)
7. A Look at Lifestyles (PLT #89, Elem.)
8. Forest Consequences (PLT #89, Elem.)
9. Discussion and Elaboration of Forest Consequences
10. Who Runs This Place? (PLT #33, Sec.)
11. Official Visit (Continuation of Lesson 10)
12. My Use of Your Use or Our Use? (PLT #45, Elem.)
13. 14. Continuation and Elaboration of Lesson 12.

These lessons also appear in Appendix B.

The second day of the workshop was devoted to close scrutiny and revision of the lessons selected. In cases where existing Project Learning Tree lessons were altered, the reasons were:

-- to substitute Canadian terms and references for American ones,
-- to replace English measures with metric terms,
-- to delete activities felt to be impractical for most classroom teachers,
-- to structure a lesson to require only a single class period, or
-- to provide linking material from one lesson to another.

Teachers' Guides

As each lesson was considered, guide material for teachers was developed. (The Teachers' Guides are included with the lessons as part of Appendix B.) While the structure and extensiveness of the Teachers' Guides differs somewhat from grade to grade, generally, suggested activities, required materials and related Project Learning Tree lessons are specified for each activity in the unit.

While most of the second day was spent sequencing units, linking them to the B.C. Core Curriculum, revising and editing lessons, and preparing the Teachers' Guides within grade-level work teams, an opportunity was provided for different teams to share experiences and developments over an extended lunch meeting. Each group described the theme and general nature of its unit, described some of its problem-solving activities, and offered a progress report. Members of the evaluation team, resource people and the Project Learning Tree facilitator shared in this exchange.

The workshop was scheduled to end at noon of the third day. Some time was provided in the morning for teams to do a final review and editing of the units and teachers' guides.

Evaluation session

The remainder of the workshop was a general session, with discussion focused on:

-- evaluation of the workshop experience,

-- recruitment of teachers/sites for the field experiment,

-- suggestions for training "experimental" teachers,

-- a review of procedures and field trials for the units developed,

-- development of measurement procedures to assess PLT impact,

-- further development activities that might foster greater use of Project Learning Tree, and

-- general comments on the Project Learning Tree workshops and the use of Project Learning Tree in British Columbia.

These discussions were led variously by members of the evaluation team and by the Project Learning Tree facilitator. The reaction to the workshop itself and to the materials developed was extremely positive. Teachers expressed particular satisfaction with the opportunity to exchange ideas and experiences with those from other districts. All of the participants indicated willingness to field-test the lessons in their own classrooms; several identified colleagues who would, they felt, be eager to try the units. The teachers were also interested in reviewing the units before the field experiment began, and many wished to try out draft versions of the tests as they became available.

Those who had worked to develop the units felt that any teacher, given a Project Learning Tree workshop and the required materials, would be able to execute the intended instruction. They were adamant

regarding the necessity of providing teachers with complete materials kits and required supplementary materials, pointing out the extent of competing demands on teacher preparation time in the elementary grades.

A number of general and specific ideas regarding test development were offered. Particularly for the Grades 3 and 7 units, teachers were concerned that the affective component of the units be assessed. Some discussion regarding the utility of various response formats -- particularly at Grade three -- took place, and the strong suggestion was offered that pictoral materials be considered. Teachers were also concerned that any estimation of cognitive change be closely tied to the specific objectives of the unit, and rejected the possibility of "importing" any existing test to assess program gains. The tests, they felt, must be designed to the specifications of the units and the grade levels involved.

A number of interesting comments and suggestions were elicited by the Project Learning Tree facilitator regarding the format and content of the Project Learning Tree training workshops, and the utility of the materials in their present form. Several teachers suggested that the local development of units such as those developed at the current workshop would lead to much more extensive use of the Project Learning Tree materials. While teachers appreciated the flexibility offered by the two Project Learning Tree manuals, many who intended to use the materials were overwhelmed by competing priorities, and, in spite of their sincere interest and intent, "shelved" the manuals for future reference following a workshop experience, failing to exploit their potential instructional value.

The systematic outlining of short "units" designed for various grade levels which could be followed through over a period of time would, the participants thought, increase the probability that interested teachers would use the materials.

A recurring theme in the general discussion of Project Learning Tree in B.C. dealt with the difficulties teachers encountered in obtaining materials. While they agreed that most of the materials -- tree cookies, blocks of aromatic wood, etc. -- were available, and that the Project Learning Tree facilitator and the Canadian Forestry Association were most helpful in providing them, they again described the various priorities which compete for classroom teachers' little available preparation time. Several of the participants concurred that the providing of "kits" which might include a range of related materials would be of great assistance.

Review/Revision of the Units

In the six-week period following the workshops, the units were subjected to close scrutiny by the Project Learning Tree facilitators (at this point, two were involved), members of the evaluation team, a research assistant whose primary responsibility was the development of camera-ready copy of the units and Teachers' Guides, and the resource people involved in the workshop. Draft copies of the units and Teachers' Guides were carefully edited, and subjected both to individual and committee review. At a final review meeting, written comments

were also available from several of the workshop teachers who had had an opportunity to use the units in their classrooms. Many of their suggestions were incorporated. Following this one-day meeting, the Teachers' Guides and those portions of the Project Learning Tree lessons which had undergone revision were submitted to a typist, and camera-ready copy produced.

In their final format (see Appendix B) the units and Teachers' Guides were printed and spiral bound; a common format was used, but the covers for the three grade levels were printed on paper of three different colours.

INSTRUMENTATION

Responsibility for development of affective and cognitive outcome measures for each of the experimental units was shared by four members of the evaluation team, with consultation and assistance provided by the Project Learning Tree facilitator, and editing by a research assistant.

Affective measures: Grade three

Development activities for an attitude measure to be used with the Grade three unit were begun immediately following the unit development workshop. A series of meetings was held, resulting in the following decisions:

- -- to achieve compatibility with the instructional unit, the measure should focus on general attitudes towards trees and forests,
- -- the instrument should minimize verbal skill requirements in both understanding the test and in responding to it,
- -- administration time should not exceed fifteen minutes, and
- -- no special skills would be required to administer the test.

The use of pictoral stimuli, suggested in discussions at the workshop, was identified as a desirable feature early in the test development sessions. Because the grade three unit focused so clearly on developing awareness of trees, the team sought to construct an instrument which could be administered both pre- and post-instruction, to facilitate the estimation

of change. After a series of deliberations, the evaluation team selected a format which combined a slide show with an individual response scale.

This format appeared to have a number of advantages:

-- young children generally respond well to audio-visual materials,

-- slides are relatively inexpensive to produce and copy,

-- elementary schools maintain slide projectors as part of their support equipment,

-- sets of slides are readily transported from one classroom to another, and

-- most teachers are familiar with the operation of a slide projector.

Next, a tentative list of subjects was developed; some of these were designed to produce positive responses (for example, a forester tending young trees) and some to produce negative responses (for example, tree trunks mutilated by carving). The Project Learning Tree facilitator was consulted regarding possible sources of slides, and endorsed their use for testing purposes.

The B.C. Forest Research Service (B.C.F.R.S.), a branch of the provincial Ministry of Lands and Forests in Victoria, B.C. maintains an extensive file of slides and photographs relating to forestry in the province. Their assistance was solicited by the Canadian Forestry Association, and their slide collection and copying service made available to the evaluation team. Two members of the team spent one day perusing the slide collection, and selected 120 slides for further review. Copies of the slides were provided by the B.C. Forest Research Service.

At the same time, local Project Learning Tree staff, referring to lists of suggested subjects, took over 40 slides which were considered for inclusion.

At this point, it became necessary to define desirable characteristics of the set of slides which would eventually be the basis of the attitude measure. These desiderata were:

-- an equal number of positive and negative situations should be presented,

-- slides which were particularly aesthetically pleasing should not be included,

-- slides of positive situations which consistently elicited positive responses from students unfamiliar with the unit concepts should not be included,

-- slides of negative situations which elicited only strong negative reactions should not be included, and

-- no more than 45 slides would be included in pilot testing.

One member of the evaluation team, working with a convenience sample of grades three and five students who had not received instruction in the Project Learning Tree concepts, reduced the set of 160 slides to a set of 80. Because the instrument was intended to assess change in attitudes following instruction, it was important that negative situations not be invariably perceived as negative by uninitiated children -- for example, slides depicting forest fires were rejected, as all children queried labelled them "very bad", "terrible", or "really sad". Portrayals of extremely positive or aesthetically pleasing situations which invariably evoked responses such as "That's beautiful!", or "What a neat picture!", or "That's a good thing to do" were similarly rejected.

At the same time as sample children reacted to the original slide collection, scales employing various anchor-formats and numbers of options were pilot-tested. The children reacted most positively to a "happy face - sad face scale", containing five alternatives:

They appeared able to select quickly from among five options: the entire range of five points was used in this comparatively small and homogeneous sample, suggesting that the format had the potential of indexing existing variations in attitudes.

At this point, a meeting of the evaluation team, the Project Learning Tree facilitators, and the resource people was held to select the final set of slides, and the presentation and response format. A grade three student attended the meeting to provide guidance and offer reactions to the team. Slides which appeared to elicit a neutral reaction, for example "It's okay, but it's pretty boring", were given a high priority as offering the best opportunity for indicating changes in attitude resulting from exposure to the Project Learning Tree materials. It became apparent, from the child's reactions and questions, that a verbal label or title should be attached to each slide in order to clarify the activities or situations portrayed. For example, young children could not be expected to readily identify such features as wind damage, erosion or beaver damage. This meeting resulted in the selection of a set of 40 slides to be used in pilot testing.

The list of "titles", to be read by the test administrator, is given below with "+" indicating presentation of a positive situation, and "-" indicating a negative situation:

Picture Sequence and Titles

1. A man looking at a young tree (+)
2. After a forest fire (-)
3. A stack of lumber (+)
4. Planting a young tree (+)
5. A new forest (+)
6. A log cabin (+)
7. A logging truck (+)
8. Water making a gully (-)
9. A fallen tree (-)
10. After a forest fire (-)
11. A tree trunk (-)
12. A young tree (+)
13. A tree fort (-)
14. Young trees (+)
15. A man falling a tree (+)
16. A burned tree trunk (-)
17. A tree nursery (+)
18. Pine trees (+)
19. Planting a young tree (+)
20. Trees in water (-)
21. A tree trunk (-)
22. A beaver dam (-)
23. Two Christmas trees (-)
24. A planted forest (+)
25. A bunch of trees (+)
26. A tree trunk (-)
27. After a forest fire (-)
28. A tree chewed by beavers (-)

29. Snow making a tree fall (-)
30. A tree hit by lightning (-)
31. A logger cutting a tree (+)
32. Men have been logging (-)
33. Logging with cats (-)
34. Trees hanging on the edge of a stream (-)
35. Trees pushed down by wind (-)
36. Lightning (-)
37. A planted forest (+)
38. A tree trunk (-)
39. A planted forest (+)
40. Two men looking at a young tree (+)

Instructions to the students and a set of response scales are included as part of Appendix C. Duplicate sets of slides were obtained, and three teachers in the Coquitlam School District were recruited to pilot test the slide/response format.

Affective tests: Grade five

Deliberations regarding an affective measure to accompany the Grade five unit resulted in a list of criteria almost identical to that developed for the Grade three instrument. Consequently, Grade five children were invited to participate in the slide-selection process, and their reactions were consistent with those of the Grade three children. The instrument appeared suitable for use with both Project Learning Tree units, and Grade five classrooms were included in the pilot test sites. Their responses and reactions were considered both separately from and together with the Grade three responses. There were no apparent differences between the two grade levels, and the evaluation, resource and Project Learning

Tree representatives concluded that the same instrument would provide a valid measure of affective changes at both grade levels. The slide-response task was assigned to both grade three and grade five units.

Teacher and student reactions to the test instrument were extremely favourable. Teachers found it easy to administer, and students found it an engaging task. Total administration time was approximately ten minutes. Students appeared to have no difficulty in understanding the task, or in using the response scale. Additionally, teachers commented favourably on the face validity of the instrument: students they identified as having extremely positive attitudes toward trees had responded positively to portrayals of positive situations and negatively to negative situations.

Analysis of the pilot test data

Response sheets for the twenty-five grade three and twenty-five grade five students who participated in the pilot test were first examined for evidence of response set. All but three students had used the range of responses available.

Results were then tabulated, and the data subjected to an item and test analysis. Results of the initial analysis are presented in Table 1. The internal consistency reliability of the set of forty items was considered insufficient for research use of the

Table 1

Summary of Results: Initial Analysis of Grades 3 and 5 Affective Test Pilot Data

Grade	n	range	mean[1]	sd[2]	rel[3]	SEM[4]
3	25	121-174	142.5	12.6	.73	6.5
5	25	127-154	143.6	8.8	.55	5.8
Combined:	50	121-174	142.9	10.9	.68	6.1

[1] possible score = 200 for set of 40 items

[2] standard deviation

[3] reliability calculated as Hoyt's ANOVA for internal consistency

[4] standard error of measurement

instrument; consequently, fourteen items with low discrimination indices were deleted, and the data re-analyzed. As indicated in Table 2, the internal consistency reliability for the revised set of twenty-six items was much higher, and the variability among scores increased.

An examination of the deleted items showed that all but one of the items dealing with the logging industry had been deleted. In an effort to gain some insight into the problem, an item factor analysis -- image analysis followed by varimax rotation -- was executed. Results showed factor loadings greater than .53 on the first factor for the seven logging items; loadings on the first factor for the other thirty-three items were relatively low.

On the basis of these results, the test items were re-analyzed as two subtests: the first encompassed the seven logging items; the second, twenty-five items with relatively high discrimination indices in earlier item analyses. Subsequently, eight items were deleted from this second group. Results of the analyses are presented in Table 3, and indicate relatively high internal consistency for each of the subtests. Evidently, attitude toward forests/trees is a construct different from attitude toward logging, though the computed correlation between the subtests (with individual items equally weighted within subtests) was .65. There was little difference between grades three and five; indeed, pilot tests teachers suggested that the test could be used from kindergarten through grade seven.

Table 2

Summary of Results: Re-Analysis of Grades 3 and 5
Affective Test Pilot Data

Grade	n	range	mean[1]	sd	rel	SEM
3	25	63-130	93.0	14.9	.87	4.31
5	25	71-109	94.7	12.3	.87	4.84
Combined:	50	63-130	93.8	13.1	.89	4.56

[1] possible score = 130 for set of 26 items

Table 3

Summary of Results: Analysis of Grades 3 and 5
Affective Pilot Test as Two Subtests

Subtest	Grade	n	range	mean[1]	sd	rel	SEM
Logging	3	25	7-30	20.9	6.0	.87	2.0
	5	25	11-26	18.2	4.4	.75	2.0
Combined:		50	7-30	19.5	5.7	.85	2.0
Forests	3	25	61-125	89.4	13.9	.88	4.8
	5	25	68-104	91.1	11.9	.87	4.3
Combined:		50	61-125	89.8	12.3	.86	4.5

[1] possible score = 35 for 7 logging items, 125 for 25 forest items

One problem was encountered in revising the instrument by deleting eight items; most deleted items had a positive polarity. If the test were administered in its reduced (thirty-two items) form, a negative response set might be induced. To guard against this possibility, it was decided to administer the test in its original forty-item format, although it would be scored as follows:

Subtest 1 (Logging)
- Items 3, 7, 15, 23, 31, 32, 33

Subtest 2 (Forest/Trees)
- Items 1, 2, 4, 8, 9, 10, 11, 12, 13, 16, 17, 20, 21, 22, 26, 27, 28, 29, 30, 34, 35, 36, 37, 38, 40

Deleted (not scored)
- Items 5, 6, 14, 18, 19, 24, 25, 39

Affective test: Grade seven

The requirements of an affective measure to accompany the grade seven unit were identified as being quite distinct from those outlined for the grades three and five units. The grade seven unit was designed to moderate extreme positions on the development of forest resources, and to foster an awareness of responsible use. Through a series of discussions of the lessons comprising the unit, and the ways in which change in student attitudes might be manifested, the evaluation team and Project Learning Tree facilitators gradually arrived at the concept of providing a series of anecdotes about resource management, each accompanied by a list of alternatives from which the student could choose. Following a brainstorming session, one member of the team was assigned the task of developing the anecdotes, while the others provided consultation and considered alternate response formats: rank ordering of alternatives; dichotomous response scales for each alternative; three-, four- and five-point "agree/disagree" scales; selection of a single alternative as being "closest to what I believe"; etc.

A sample anecdote, with alternative positions, is given in Figure 1.

On the north side of town there is a piece of land approximately 2 km by 1 km. It is covered with heavy forest and has never been used. The owner died recently, and the cousin who inherited the property doesn't know what to do with it. Four of the local citizens have visited the new owner. Each one has a different idea of how the land can best be used.

1. Flo Fletcher, Mayor	"Sell the land to the town and we will build a wildlife and recreation park for the citizens to use."
2. Ray Pearce	"Sell it to me and I will leave it as it is."
3. Eddie Evans	"Sell the land to my development company. We will have it logged, then we'll use the land to develop a new housing subdivision."
4. Dale Doffman	"Sell the land to my logging company and we will agree to log it, and replant the area to trees."

Figure 1: Sample anecdote, grade 7 affective scale

Response assignments for this item were:

1. recreational developer
2. extreme conservationist
3. irresponsible developer
4. responsible developer

A five-point scale, anchored as illustrated below, was provided for each of the four positions stated after each anecdote:

Strongly Agree	Agree	Can't Decide	Disagree	Strongly Disagree
A	B	C	D	E

It was felt that indicating degree of concurrence with each of four solutions to a problem described would enhance the variability in response patterns and permit the estimation of change from extreme to moderate positions.

The instrument was pilot tested in two grade seven classrooms in Vancouver. Again, both students and teachers found it an engaging task. Some concern was expressed concerning its length, and teachers offered a number of constructive suggestions for revision.

Analysis of the results

A number of scoring procedures were tried in analyzing the results. The four positions offered were treated as four subtests, and grouped accordingly. Thus for each of the six anecdotes, one position was labelled "irresponsible development", grouped with the other five "irresponsible development" scales, and examined for internal consistency and variability across anecdotes. A similar procedure was followed for "responsible development",

"extreme conservation" and "recreational development". Two problems were immediately apparent: the range of alternate positions was not qualitatively equivalent from one anecdote to another, and one of the anecdotes (A) did not appear to be tapping the same attitudes as the others. The instrument was revised accordingly, by equating response options over items and eliminating item A. (See Appendix C for the final version of the instrument.)

A further problem arose in the weighting of various response options. It was desirable that:

-- responses indicating moderate positions be equally weighted; that is, strongly agreeing with a responsible alternative while strongly disagreeing with irresponsible positions ought to yield similar item "scores:;

-- the irresponsible extreme positions should be scaled as equally distant from the responsible positions, but still be distinguished from each other; that is, a student "score" should be interpretable as representing one of the four positions offered; and

-- each student should receive a single total score.

Experimentation with various weighting systems led to the conclusion that a five-point scale with a mid-point anchored "Can't Decide" was unwieldy in terms of yielding a total score. In fact, the "Can't Decide" option itself failed to provide useful information and was not consonant with various weighting systems. Thus, the response scale was revised to eliminate the mid-point. Specifics of the scoring procedures are described in the section entitled "Results".

Measures of achievement

Objectives-referenced achievement tests were developed for each of the instructional units. Identical procedures were followed for each grade level:

1. Instructional objectives were identified for each lesson.
2. Identified objectives associated with the cognitive domain -- and considered appropriate for paper and pencil testing -- were assigned to the test plan.
3. Several items of various formats were developed for each objective.
4. Approximate weights were determined for groups of objectives.
5. General test format was determined.
6. Items were selected according to the specifications of content, format, and priority weightings.
7. Tests were assembled and field tested with convenience samples at appropriate grade levels to obtain data on readability, time demands, and any format problems.
8. Tests were reviewed by evaluation, resource, and Project Learning Tree personnel.
9. Art work and graphics specifications were prepared and contracted.
10. Tests were assembled and edited to camera-ready state by a research assistant.

Objectives tested for each of the grade levels are presented in Tables 4, 5 and 6; for each objective, the originating lesson is given, along with the corresponding test item numbers. While these tables provide a general outline of test-lesson correspondence, it should be recognized that many of the objectives recur in lessons throughout the unit. Generally, they have been attributed

Table 4

Specifications for Grade Three Achievement Test

Lesson	Objectives	Item
1	Identify parts of a tree using tactile perception.	12
	Classify parts of a tree as deciduous (leaves, seeds) coniferous (cones, needles)	13 "Mixed Up"
2	Identify and locate tree parts.	10
	Recognize the functions of tree parts.	9, 11
3	Recognize characteristics that indicate a tree is living.	"Dead or Alive"
	Recognize that trees are most often dormant in winter.	8
4	Identify reasons for needing consistency in measurement.	5
	Define terms: circumference, diameter.	7, 6
	Identify location of branches by relative thickness.	1
	Recognize that the thickest part of the tree trunk is at the bottom and the thinnest at the top.	2
6	Identify the relationship between tree rings and tree growth.	14, 15, 18
	Recognize reasons for differences in width of tree rings.	16
	Recognize that new rings are added to the outside of the tree.	17
8	Identify geometric shapes -- triange, rectangle, circle, square -- which occur naturally in trees and other plants.	"Hidden Shapes"
12	List human, animal and natural harmful effects on trees.	3 "Trembling Tree"
	List requirements for healthy tree growth.	4

Table 5

Specifications for Grade Five Achievement Test

Lesson	Objective	Item
1	Match soil names with characteristics including texture, influence on water involvement, composition, utility, and density.	I 1-7 II 11 V 31
2	Interpret a growth graph.	V 22-25
3	Identify the age of a tree part by counting the annual rings.	II 17,21
	Demonstrate the relationship between growth conditions and width of annual rings.	II 18,19
	Indicate that new growth occurs on the outside of the tree.	II 20
4	Recognize the effects of lack of sunlight on plant leaves.	II 8,28
5,6	Define natural succession.	II 12
	Identify relationships between environment and species.	II 9,10
7	Select characteristics which aid in identifying the species.	II 16 V 26,29
8	Differentiate among leaves on the basis of size, shape, texture, colour.	V 27,30
9,10	Predict consequences of human effects on forested area.	IX A,B,C
11	Distinguish between renewable and non-renewable resources used in the home.	III
12	Identify ways forest products are used in recreational activities.	VII
13	Given the total weight of paper used in a classroom, compute the average weight used per student.	II 13
	Given the weight of paper used by one student in one day, calculate: a) total weight used by the class in one day, and b) total weight used by a student in one week.	 II 14 II 15
	List strategies for conserving resources in classroom.	IX
14	Identify inappropriate behaviour in the outdoors.	X
	Explain why certain activities are inappropriate in the outdoors.	X

Table 6

Specifications for Grade Seven Achievement Test

Lesson	Objective	Item
1	Identify components of a forest.	24,28
	Recognize economic values in a forest.	1,2,4,14, 19,20
	Place value on components of a forest.	19,20,25,27
2/7	Distinguish between requirements for human survival, and desired products.	"Wants and Needs", 26
3	Distinguish between conservation and preservation.	3
	Identify consequences of various personal, commercial, community and interest group land use in terms of other values.	5,6,9,11,12, 16,17
4	List ways in which living trees improve the quality of life.	"Uses for Trees"
5.	Identify regulations regarding the use of public recreation areas.	7,10,18
	Select major source of financial support for parks.	13,15,21,23
6	Distinguish between renewable and non-renewable resources.	"Renewable or Non-Renewable Resources"
8-14	Project consequences of human activities in forested areas.	"Forest Consequences"
	Identify the major land owner in B.C.	22

to the lesson in which they were first introduced. It is the case that the objectives listed in these tables do not represent the full range of objectives for each unit; rather, they represent those cognitive objectives which the evaluation team felt could be validly assessed in a paper-and-pencil test situation. Obviously, the affective and many of the performance objectives central to many of the lessons did not qualify.

Item formats were selected for their compatability with the objectives, and their appropriateness for the grade level in question. As tests were assembled and reviewed, items were grouped by format and response requirements. Care was taken that students be presented with some variety in item-type, but at the same time, not be required to change their frame of reference too frequently. Tests at all levels contain both selection and open-ended questions, and are composed primarily of questions designed to elicit evidence of comprehension, application and analysis.

In the early development stages of the grade three tests, the decision was made to provide a unifying theme. Two characters -- Sherlock Hemlock[1] and Arlene Arbutus, tree detectives -- were developed. They are introduced on the first page, and the child is asked to enter the role of assisting them in their detecting. In addition to enhancing the appeal of the tests, the use of a theme allows children to move through a series of diverse activities while maintaining a central focus. (Arlene and Sherlock are introduced in Appendix C.)

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[1] This name was borrowed from a Sesame Street character, but the similarity is in name only. We are grateful for the inspiration.

Because the tests were objective-referenced and designed to test only those objectives developed in the units, little useful item-level data could be obtained from pilot tests: it was anticipated that prior to completion of the units, most children would be unable to respond correctly to the items. No classes which had completed the unit were available. Although it was not possible to obtain useful item data, it was important that the tests be checked for appropriateness of the time limits, the reading demands, and the item formats. Again, conventional samples from appropriate grade levels were used; teachers and students reported no difficulties with readability or item formats. While the grade five and seven tests appeared to be of apropriate length, the grade three test demanded an excessive amount of time to complete; consequently, after review, the number of items was reduced from thirty to twenty-two.

As with all other materials developed in the course of the evaluation, the penultimate activity was a review meeting involving the evaluation team, Project Learning Tree facilitators and resource people. Items were checked once more for clarity, and content validity, and a key was developed for each test.

In order to enhance motivation, to prevent excessive demands in terms of reading comprehension and to provide valid surrogates for many of the Project Learning Tree activities, tests at grades three and five were designed to rely heavily on graphic materials.

An artist was contracted to provide drawings to specifications for item requirements, and to develop a theme character -- a lumberjack in various poses who would appear throughout all of the tests, as shown below:

FIELD EXECUTION

Selection of sites

The original evaluation plan called for the field experiment to be carried out in a minimum of two sites. Responses to the survey conducted as part of Phase I had indicated that the most likely "prime" site outside of the Lower Mainland/Fraser Valley region would be in one of the Vancouver Island communities: Victoria, Nanaimo, or Campbell River. Each of these sites was explored through discussion with district level personnel and teacher contacts established in earlier activities. Although pockets of interest occurred in Campbell River, it was soon apparent that these would not be substantial enough to support the field experiment. School district level personnel in Victoria were eager to host the study; however, they were unable to recruit a suitable sample of teachers/classes. Nanaimo had been considered a prime site since the early returns of the Phase I surveys, and subsequent development activities confirmed the desirability of the site. The area is primarily dependent on the forest industry, interest in Project Learning Tree and Project Learning Tree workshops was strong, an effective local coordinator was available, and the required support was available from school board administrators and school principals.

The Prince George area was also explored as an experimental site -- a number of interested teachers could be located in the district, Project Learning Tree workshops in the area had been

well-received, and district level administrators were receptive. Unfortunately, a number of prior commitments to research and inservice activities in the district exhausted the efforts local officials felt could fairly be devoted to research and development during the 1979-80 school year.

From the outset of Phase II, suburban areas in the Fraser Valley had been considered desirable as locations for the experiment. Two of the districts in the area -- Coquitlam and Surrey -- shared a number of advantages: district level coordinators had offered their cooperation in responses to the earlier surveys, and teachers in several schools were interested in participating. Recruitment activities were thus focused in these areas.

Recruitment

Recruitment of teachers/classes for participation in the field experiment followed two major thrusts: local coordinators identified interested teachers within the constraints of the design, and the evaluation team, in consultation with Project Learning Tree personnel, selected individuals with whom previous contact had been established.

In one district, an initial base of potential experimental teachers was identified from teacher-contacts established in Phase I. Local primary and intermediate supervisors then recruited enough teachers to complete design requirements. Again, it was not possible to restrict the experiment to two schools and still procure the desired (student) sample size.

In the second district, where the outdoor education coordinator had expressed interest in being the local coordinator, four teachers at each grade level of interest were recruited through his efforts; all were volunteers with only limited experience with Project Learning Tree, but each had an interest in enhancing systematic instruction in environmental education. While it had been considered desirable to limit the physical scope of the experiment to just two schools -- one for each treatment level -- in order to facilitate communications and control during the experiment, six different schools were eventually involved. With one exception, however, both classrooms at a single grade within a treatment group were located in the same school.

At the third site, teachers were recruited by the coordinator, a teacher-librarian who had been involved in the unit development workshops and reviews of materials. In this district, the energy and persuasion of the coordinator assured that specifications of the original design were met: two neighbouring schools were involved, with at least two classes in each school at each grade level involved.

The sample, as it appeared at the initiation of the study, is given in Table 7.

Table 7

Sample of Initiation of Field Experiment

Site		Grades 3	5	7	Totals
Treatment A: (Pretest, Instruction, Posttest)					
District 1	No. of teachers	2	2	2	6
(C)	No. of classes	2	2	2	6
	No. of students	48	57	54	159
District 2	No. of teachers	2	2	2	6
(S)	No. of classes	2	2	2	6
	No. of students	50	53	52	155
District 3	No. of teachers	2	2(tm)	2	6
(N)	No. of classes	2	2(tm)	2	6
	No. of students	50	51	48	149
		148	161	154	463
Treatment B: (Pretest, Waitlist, Test, Instruction, Posttest)					
District 1	No. of teachers	2	2	2	6
(C)	No. of classes	2	2	4	8
	No. of students	51	63	125	239
District 2	No. of teachers	2	1	2	5
(S)	No. of classes	2	2	2	6
	No. of students	43	50	53	146
District 3	No. of teachers	3	4	3	10
(N)	No. of classes	3	4	3	10
	No. of students	76	101	78	255
		170	214	256	640

Training workshops.

In consultation with the local coordinators, training workshops for teachers involved in the field study were scheduled; some of these were in the late afternoon, while others were held during the school day with release-time arrangements made with local school districts. Originally, six workshops were anticipated: one for each of Treatment A and Treatment B in each of the districts. Given the vagaries of teacher schedules, this goal proved unattainable. Additionally, in the Lower Mainland/Fraser Valley sites some last-minute shuffling of experimental teachers (and, in one district, a communication breakdown between coordinator and participating teachers) forced the scheduling of several additional training sessions. Two workshops -- one morning and one afternoon -- were sufficient for the Vancouver Island site.

The workshops were designed and presented as a cooperative activity of the Project Learning Tree facilitator and the evaluation team, with the same member of the evaluation/resource group directing each. The format was consistent from one workshop to another, with some minor variations to accommodate individual teacher concerns. A member of the evaluation team functioned as participant-oberser at each workshop. The account which follows details a "typical" training session.

Participant-observer's account of a training session.

The workshop director greeted teachers, introduced other evaluation and Project Learning Tree members present, and provided a brief description of the evaluation objectives. He then introduced the Project Learning Tree facilitator who reviewed the history, philosophy and organization of Project Learning Tree. She described the initiation of the program by the American Forest Institute, which had wished to develop a flexible program, useful across subject areas and grades, to deal with "Man and his environment" -- specificially the student and his environment. Involvement of the Weyerhauser Foundation and the Canadian Forestry Association was discussed and the independence of the educational activities from logging-forestry companies emphasized. Developmental activities -- the involvement of teachers in design of the lessons and manuals, and the decision to make each lesson independent of the others, so that teachers could "pick and choose" those which best suited the needs of their classes.

The facilitator underlined the philosophy of "learning by doing" -- a process approach focused on active participation in discussion, brainstorming and group/individual "hands on" activities, rather than on a series of paper and pencil tasks. She pointed out that the subject matter is forest resources, and that the program is set up to bring students to an understanding of ways in which forests are used. As the facilitator turned to a discussion of the manuals, she noted a number of naturally occurring "good fit" with the B.C. Core Curriculum.

Using the elementary P.L.T. manual, she went through organizational and content features, paying specific attention to the delineation of the Project Learning Tree principles, the cross-referencing, the curriculum framework (p. 160), the specification of Intellectual Evaluative Skills, the topic index, the glossary (p. 153), and the lists of publishers, resource materials and addresses, and reported on availability of resource lists and references developed in British Columbia. Throughout the presentation, she emphasized the flexibility of the program, the independence of individual lessons, and the integration of curriculum area. Following this half-hour presentation, questions were entertained.

The director of the workshop then provided the background and rationale for the evaluation, describing the results of the Phase I study and the overwhelmingly positive response from teachers who had attended Project Learning Tree workshops. He pointed out that the question "How do children change as a result of Project Learning Tree activities?" had not yet been answered, and noted that one of the strongest features of the program -- its flexibility -- mitigated against systematic assessment of effects. He then described the strategy selected for the B.C. evaluation, involving Weyerhauser Foundation, the Canadian Forestry Association, the University of B.C., and three school districts, and outlined the process by which discrete units of instruction had been developed. He briefly described the focus of each unit and emphasized the role of affective as well as cognitive objectives.

Following this fifteen-minute presentation, the units were distributed and coffee and doughnuts served while informal examination and discussion took place. Next, teachers at each grade level were "walked through" the relevant unit with the director, Project Learning Tree facilitator and the participant-observer serving as leaders. During this activity, "kits" of required materials -- seeds, tree cookies, aromatic wood, reference information, etc. -- were displayed and teachers shown which "kit" to take with them.

When the teachers in each grade level group appeared comfortable with their unit, the whole group was reassembled for a description of the experimental design and the required testing procedures. Specific testing dates were given, and start-finish dates for instruction. The importance of maintaining the specified time line was emphasized, and the names and telephone numbers of local Project Learning Tree and University of B.C. contact persons distributed. Teachers were urged to approach one of the contacts immediately, should they encounter any problems or feel any concern about delivery of the program. Development of the tests and instructions for administration were described. Particular attention was given to the grade three and five affective test -- the slide/response scale combination. Standardized instructions were given regarding timing of the slides and presentation of the titles. Logistics for moving one set of slides from one classroom to another were presented.

Evaluation team members emphasized the confidentiality of individual student and class results, pointing out that the final report, while recognizing the contribution of participating teachers, would present only aggregated results, whith no attending identification of teachers or classes; teachers would be acknowledged simply by district, without treatment level designation. Teachers were also advised to anticipate classroom observation visits by members of the evaluation team, and assured that these would occur at their convenience.

The remaining time was devoted to specific questions and comments from the teachers; most of these dealt with specifics of test delivery, contacts and timing.

For the most part, teacher response to the workshops and the experiment was extremely enthusiastic. Teachers liked the units and the support materials, and they were intrigued by the tests. Most concerns voiced involved time pressures.

Project Learning Tree and evaluation team members were generally pleased with the results of the teacher recruitment, although following the workshop series concerns were voiced regarding the committment of some of the District 2 teachers and coordinating personnel.

Initial testing

The design called for all students to receive the affective test immediately prior to the initiation of instruction for the Treatment "A" group. In the Lower Mainland/Fraser Valley districts, a member of the evaluation team delivered the tests personally to each teacher, reviewed procedures and responded to concerns. Because the grade 3 and 5 affective testing required the physical movement of the stimulus slides from one school to another, these, along with the response sheets, were delivered to and retrieved from each grade 3 and 5 teacher to ensure their availability in specific classrooms on the required dates; thus, most teachers in these districts received two visits in the initial phase of the experiment. A number of minor concerns and misconceptions were consequently cleared up, and most teachers appeared eager and confident.

In the Vancouver Island District, all testing was supervised by the local coordinator; in fact, this individual actually administered all of the grade three and five affective tests, ensuring standardization of the process and adherence to the schedule. Sufficient tests for all phases of the experiment had been delivered to her at the time of the training workshops.

Site visits

In addition to the visits made in connection with the pretests, the evaluation team visited each participating teacher at least once during the experiment -- generally, just prior to the

second testing period. Where scheduling permitted, classes, as well as teachers, were visited. During this round of visits, all further required testing materials were delivered, scheduling re-confirmed and any teacher concerns addressed. At this point, most of the Treatment A teachers were nearing completion of the unit; the only serious difficulties reported involved maintaining the time line. Several teachers noted that their classes were increasingly subject to interruptions characteristic of Spring term -- other testing, assemblies, sports days and district music programs. Treatment B teachers appeared anxious to begin; many had planned tie-ins with field trips and other activities; in one school, they indicated a desire to use the units -- but not the tests -- for a special population for which they shared some responsibility. One grade seven teacher developed a supplementary lesson centred on a field trip to the U.B.C. Research Forest at Maple Ridge, B.C. (A description of the forest and the schedule, stimulus materials and some outcome materials from the field trip are included as Appendix D.) This experimental forest operates research, education and demonstration programs. The Outdoor Education Program has been developed as a service to B.C. schools, with over 5500 students a year visiting the forest.

Two members of the evaluation team visited each teacher at the Vancouver Island site; additionally, they were able between them to observe four of the Treatment B classes who had just begun the unit. Treatment A teachers were interviewed, and expressed satisfaction with the program; many indicated intentions to proceed with other Project Learning Tree activities, now that they had completed the experimental units. Classes which had 'adopted' trees were persisting in their visits and observations. The Treatment A teachers shared a number of their experiences. One recounted how, on coming upon a man with a chainsaw who was beachcombing, she had asked if he would cut her some large "tree cookies". Once he understood what she wanted, he provided her with two large cross-sections of a tree trunk. She then held a contest in her grade three class, with the winner(s) judged as the child who came the closest to estimating the tree's age -- more than one hundred years! A grade seven teacher described the final activity of his class -- a debate, with the principal invited as a judge. Others told of local resource cooperation, and described classroom visits and discussions. Many teachers mentioned the pride with which some of their students whose parents were involved in forest-related occupations shared special knowledge and experiences. In the Treatment A school, with the testing completed, some trading of lessons and materials had begun between the grade five and the grade three groups. Although the teachers -- like their Lower Mainland counterparts -- reported something of a struggle to maintain the time line, it was clear that Treatment A had been delivered as designed.

A grade seven teacher in the Treatment B school, where most teachers were working on lesson 2 or 3, graciously re-scheduled her students' activities to permit a visit from a member of the evaluation team. This visit took the form of a group interview; in fact, the students asked most of the questions. They had been working on lesson 1, and had each been assigned a small piece of research -- involving activities such as soliciting prices from lumberyards, finding out the number of employees for various forest-related activities, obtaining information on annual rainfall, and so on. They were keen to share the information they had gathered, and were also extremely interested in the evaluation project. Many of their questions had to do with the tests they had written, and how the results would be used. It was clear from the teacher's attitude and the student responses, that a fair trial of the materials would occur.

A grade five science classroom in which a review of lesson 1, and the initiation of lesson 4 (note: the lesson 4 experiment requires some time to show results) was observed. The teacher led a discussion of an experiment conducted in lesson 1: students had poured water down two small banks in the schoolground: one was grassy, the other had no vegetation. Each student had prepared a formal report of the experiment. Teacher questions focused both on the form of scientific study -- for example, the difference between "observations" and "conclusions" -- and on the information gained from the experiment. Vocabulary terms such as "erosion" were reviewed, and the implications of the findings discussed. The teacher pointed out that this was the second

experiment the students had completed in connection with lesson 1 -- the first had dealt with differences in soil types -- and integrated the findings of the two experiments through a question-and-answer format.

The field activity for lesson 4 was then introduced. The teacher noted that they had been considering two of the required elements for plant growth -- soil and moisture -- and asked for other requirements. "Sunlight" was immediately offered. She then asked a series of questions about the differential effects of depriving plants of sunlight, and concluded by telling students that they were going to perform an experiment to determine what effect the lack of sunlight had on leaves. She pointed out that although they would perform the first stages of the experiment that day, they would not observe the results until the following week. Students were each provided with pieces of heavy paper, and instructed to cut two or three distinctive shapes of their own choosing, not larger than 4cm by 4cm. Shapes produced included hearts, initials, and basic geometric figures. Students were then provided with paper clips. After each student had completed his preparations, the teacher described specific procedures: the class would go to a neighbouring park, where each student would select a broadleaf tree or plant. Each student was to select a different plant, make a note of its exact location, and, taking care not to tear the leaves, attach the cut-outs to various leaves using paper clips. She emphasized the caution required to avoid permanent damage to the plant. As there had been a recent rainfall, and the weather was cool enough to require

outerwear, students were sent to the cloakroom, one row at a time, to change their footwear and get their jackets. The preparations and exit proceeded in an orderly manner -- students were apparently accustomed to such field trips.

The organization and knowledge displayed by this teacher were impressive. Students were enthusiastic, but well-behaved, and activities were carefully scheduled to permit observation of results at the desired time -- thus the initiation of the lesson 4 experiment in sufficient time to permit an observable effect when lesson 4 occurred in sequence. The teacher appeared comfortable with the material, and treated excursions outside the classroom as matter-of-fact activities in the course of a science program. This classroom appeared to be a fortuitous site for testing the Project Learning Tree materials.

In a third classroom -- also grade five -- the observer's visit coincided with a quiet activity period. Students were individually recording their observations from an experiment just completed. Both the teacher and the students appeared keen and genuinely interested in the activity.

A grade seven class observed at this time was engaged in a discussion of implications of resource development decisions. The teacher raised and integrated issues over various situations, referring to the affective scales the students had completed as a pretest. Students were enthusiastic in espousing points of view

ranging from economic development at all costs to "leave everything as it is". While the discussion was both lively and focused, the emphasis on the scenarios from the affective scale may have biased results of the posttest.

Overall, the teacher interviews and classroom visits in District C confirmed the suitability of the schools involved as a field site. For the most part, instruction was proceeding as outlined in the unit guides, teachers and students were enthusiastic, and a number of natural tie-ins with the local forest industry were being exploited.

Samples of student work

Students in one grade five classroom graciously permitted their teacher to forward samples of their work to the evaluation team. The students had written "plant personification" stories about their adopted trees, and provided drawings.[1]

Teacher logs

In addition to interview and observational data, teacher questionnaires (see Appendix F) solicited both delivery and evaluative information. These were mailed to each participating teacher early in June 1980. Results are presented in the next section of the report.

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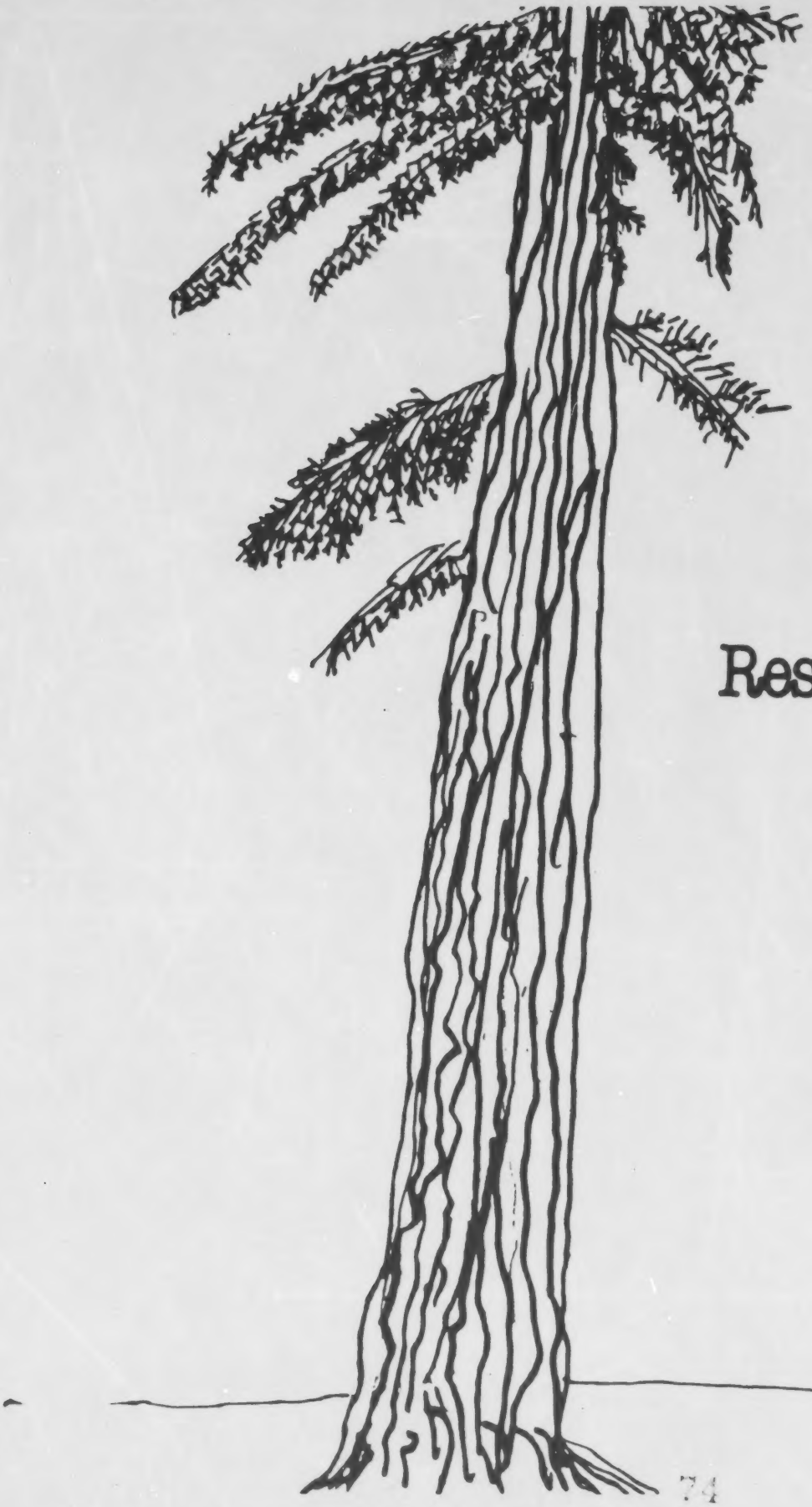
[1] Some of these drawings have been chosen as the section-separating pages in this report; others, along with some of their stories, are given in Appendix E.



Results

Teri Hester

RESULTS

Results of the Phase II field experiment are presented in four related sections:

1. First, psychometric characteristics of the tests and baseline -- entry-level -- performance are described,
2. Second, descriptive and inferential analyses performed on test scores to estimate program effects are reported,
3. Next, selected item-level results are presented to illustrate the patterns of change within each test, and
4. Finally, results of the teacher questionnaire and observations dealing with implementation and delivery are given.

Psychometric characteristics of the instruments

Grade three achievement test. Pretest administration of the grade three achievement test occurred at time 2, for only Treatment B (wait list). Student and teacher responses indicated that the test items provided a practicable set of tasks for grade three students. No difficulties in comprehending the items were reported; students found the theme and the graphics engaging; and the test was short and varied enough to avoid common testing problems such as fatigue and boredom. Teachers had been instructed to assure the children that they were not expected to be able to answer all the questions correctly; that the test was a "preview" of new

material they would be learning, and they would have another test after the new material to see how much they had learned.

Student performance on the grade three achievement pretest was considerably higher than had been anticipated. For the total sample, the mean raw score was 28.74 of a possible 43-point maximum (67%), evoking concern that at least some of the material contained in the grade three unit had already been mastered by the students, and that changes due to exposure to the Project Learning Tree unit would be difficult to detect due to possible ceiling effects of the test. Difficulty levels for items measuring some of the objectives -- for example, ability to identify basic geometric shapes -- were in excess of .95, indicating that before the unit had begun, 95 percent of the children were able to perform these tasks accurately. Internal consistency for the total test -- .52 -- was adversely affected by the high difficulty levels of such items.[1]

Grade five achievement test. As at the grade three level, teachers and students offered generally positive comments about the test, and no problems were identified in its administration. Mean raw score on the pretest for the total sample was 33.4 of a possible 59 (57%); while pretest performance for the grade five sample was somewhat higher than had been anticipated, student

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[1] A high degree of internal consistency is not an essential requirement of an objectives-referenced test. The desirability and method of a calculation of reliability for such tests has been a matter of some dispute -- as yet unresolved -- among measurement experts.

performance was more consistent from item to item than was the case for grade three. For most items, between 40 and 70 percent of students responded correctly, and Hoyt's internal consistency reliability estimate was .69. The only set of items to cause serious concern was that measuring objectives from the Outdoor Manners lesson, where almost all students scored three correct out of three possible.

Grade seven achievement test. Teachers of grade seven students also offered a number of positive comments following administration of the achievement pretests. Length, readability level and item formats were described as appropriate; students seemed readily to understand the function of a pretest, and thus did not suffer undue anxiety. Again, performance level was generally higher than had been anticipated as "entry" level, with the mean raw score for the total sample being 56.44 of a possible 83 (68%). Student performance was particularly strong on the fourteen items assessing ability to differentiate between humans' wants and needs. Clearly, achievement gains for this objective were unlikely to appear. Scores were also surprisingly high (mean = 77%) on items measuring ability to predict consequences of human activities in relation to natural resources. Inconsistencies in the difficulty level of the items, with some items completed correctly by nearly every student, contributed to a relatively low internal consistency reliability estimate of .47.

Grades three and five affective tests. Teachers and students at both grades three and five were enthusiastic about the slides and "happy face" scales.

Procedures for obtaining two scores, representing attitude toward logging and attitude toward trees respectively, were described in the earlier section of this report dealing with methods. At pilot testing, analyses had confirmed the existence of two discrete subtests, with scores of seven items aggregated to produce a reliable "logging" attitude score, while the sum of twenty-five other items provided a score which reliably represented general attitude toward trees and forests. Examination of pretest responses for both Treatment groups at time 1 confirmed that:

1. No extreme response bias was apparent, with students at both grade levels selecting from the entire range of response options,

2. The set of items for attitude toward logging did, indeed, provide a reliable estimate, with a Hoyt's analysis of variance internal consistency of .77 for grade three and .78 for grade five,

3. With the deletion of two items -- leaving a total of 23 -- a reliable score could be calculated for general attitude toward trees, with a reliability coefficient of .85 for grade three and .79 for grade five, and

4. Score distributions for each of the subtests at each grade were approximately normal.

For the Attitude Toward Logging scale, the mean response at grade three was 2.5 on a five-point scale, where "5" represented a broadly smiling face, "1" represented an extremely unhappy face, and "3" represented a "neutral" face. Mean entry-level attitude toward logging for the entire sample, then, was somewhat negative, falling between the "mildly" unhappy face and the neutral position. At grade five, the comparable mean was 2.7, slightly closer to the neutral position than that for grade three. Generally, then, at program entry, both grade three and five students indicated slightly negative attitudes toward logging.

For the Attitude Toward Trees scale, the mean grade three item response was 3.3 and the mean grade five response was 3.5 -- indicating, for both groups, a somewhat positive attitude toward trees, falling between the neutral position (3) and the mildly happy face (4). Differences between mean item scores on the two scales were considerable; clearly, children entering the program displayed much more positive attitudes toward trees than toward logging activities. Differences between the two grade levels were trivial.

Grade seven affective test. The only difficulty reported in the pretest administration of the grade seven affective instrument was that the task presented proved so engaging, that the Treatment B (wait-list) students -- whose instruction was not to begin for six weeks -- were anxious to discuss the scenarios and debate the alternatives. The affective test (see the previous section on Methods, and Appendix C) results yielded four subtest scores on attitudes toward:

1. extreme conservationist roles,
2. moderate conservation
3. responsible economic development roles, and
4. irresponsible economic development roles.

An aggregate score was also produced by combining and weighting responses for all items and solutions: high scores were associated with an extreme conservationist position, while low scores were associated with an extreme development position.

Internal consistency reliabilities for the four seven-item (one for each scenario) subtests listed above were .72, .52, .55, and .60 respectively. For the total score the internal consistency reliability was .74.

When the four subtests were considered, the strongest support was given to "responsible recreational development" roles, with a mean score of 1.9 (on the four-point scale) associated with this role. This value is located between the anchors of "agree" and "agree strongly". The total score was 21.5, where the minimum of

7 represents consistent strong agreement and 28, the maximum, represents consistent strong disagreement with a position. Student pretest support for the various positions is summarized in Table 8, where positions are rank-ordered from strongest to least support:

Table 8
Summary of Pretest Results: Grade 7 Affective Subtests

Subscale	Mean Total Score	Mean Item Score
Moderate conservation	13.5	1.9 (positive)
Extreme conservationist	16.8	2.4 (neutral)
Responsible economic development	17.7	2.5 (neutral)
Irresponsible economic	23.3	3.3 (negative)

An item score of "4" indicated strong disagreement; "3" indicated disagreement; "2" indicated agreement; and "1" strong agreement. Thus, an item mean of 2.5 indicates a neutral position, the mid-point between "disagree" and "agree".

The total score was calculated by first, reversing polarities between conservation/recreation and development positions, so that strong agreement with a conservation role resulted in an equivalent score to strong disagreement with a development position. Next, items associated with extreme roles were multiplied by a factor of 2. The resulting total scores has an associated internal consistency of .74, and approximated a normal distribution with mean of 87.5 and

range 58 to 132. On this scale, the lowest possible score -- 42 -- would represent a strong conservationist orientation, while the highest possible score -- 168 -- would represent strong support for economic development orientation; the mid-point of 105 would be associated with neutrality. The mean student score of 87.5 on this scale then, indicated a definite tendency toward the conservation/recreation positions among the students at test time 1.

Table 9

Summary: Psychometric Characteristics of the Pretests

Grade	Test	Possible Range	Mean	Standard Deviation	Reliability
3	Achievement	0- 43	28.74	4.46	.52
	Attitude: Logging	5- 35	23.72	5.38	.77
	Attitude: Trees	23-115	53.36	12.47	.85
5	Achievement	0- 59	33.40	8.06	.69
	Attitude: Logging	5- 35	23.07	5.28	.78
	Attitude: Trees	23-115	57.14	11.09	.79
7	Achievement	0- 83	56.44	7.91	.47
	Attitude:				
	Extreme Conservation	7- 28	16.81	3.65	.72
	Moderate Conserv.	7- 28	13.48	2.84	.52
	Moderate Development	7- 28	17.05	3.12	.55
	Irrespons. Develop.	7- 28	23.30	2.94	.60
	Total	42-168	87.50	13.26	.74

Achievement test results

Two sets of analyses were performed on achievement test data. The first, Analysis I, was a repeated measures analysis of variance executed to assess gains between pretest and posttest. These analyses tested for differences among districts and for pre- v.s. posttest differences within district, and involved the Treatment B students -- who had written the achievement test both before and after receiving instruction. In Analysis II, two-way analyses of variance were performed to test for differences between students who had received Project Learning Tree instruction and those who had not. All students were involved in these analyses; scores for Treatment A students who had completed the program were compared with those of Treatment B students (wait list) who had not yet begun the program at testing time 2.

Grade 3. Results of the achievement tests for grade three are summarized in Tables 10 through 13.

As indicated in Table 10, a significant difference was apparent between pretest and posttest scores. No main effect was attributable to District -- that is, students in different districts displayed generally equivalent performance -- but a significant interaction for gain-by-district did appear. Students in one district displayed significantly greater gains than did students in another district.

Examination of Table 11, which displays pre- and posttest means by district, reveals that while students in District A had a lower entry-level mean than those in District C, they demonstrated a much greater gain in scores following treatment; so great, in fact, that following exposure to the Project Learning Tree unit, their mean score was appreciably higher than that of District C. This finding suggests that the pattern of gains is substantially different from one district to another. A graphic representation of this result appears in Figure 2.

Analysis II, which compared scores of students who had not yet received Project Learning Tree instruction with these who had, confirmed this finding. As indicated in Table 12, a significant main effect for instruction appeared, as did a significant interaction between Instruction and District. This analysis also demonstrated a significant main effect for district.

Table 13 presents the mean scores for these comparisons. Again, as in Table 11, it is apparent that scores of students in District A were more greatly enhanced by the Project Learning Tree instruction than were those in District C, although the difference is not as dramatic as that demonstrated in the previous section.

Table 10

Summary Analysis of Variance Table for Pre- vs Posttest Treatment and District Effects: Grade 3 Achievement Test

Source	df	Mean Square	F	p
District	1	3.17	0.21	-
Student (within district)	68	15.25		
PRE VS POSTTEST (gains)	1	782.34	44.57	< .001
District X Gain	1	559.91	31.90	< .001
Student X Gain	68	17.55		

Table 11

Mean Pre- and Posttest Performance by District: Grade 3 Achievement Test[1]

District[2]	Mean	
	Pretest	Posttest
A	25.71	35.88
C	30.02	30.87
Combined	28.97	32.09

[1] possible score = 43

[2] As noted earlier, it was not possible to maintain the experimental design at the grade 3 level in District B. For this grade, analyses of achievement test performance are restricted to Districts A and C.

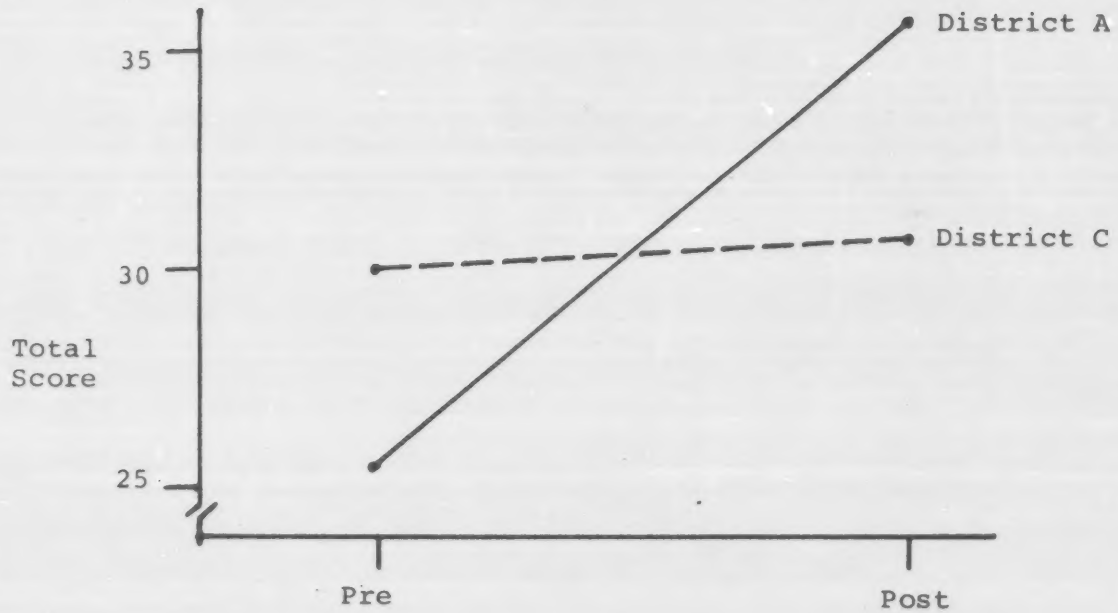


Figure 2. District differences in Grade 3 Achievement Test Gains.

Table 12

Summary Analysis of Variance Table for Treatment and District Effects: Grade 3 Achievement Test.

Source	df	MS	F	p
Instruction	1	1216.17	70.23	< .001
District	1	150.00	8.66	.004
Instruction X District	1	109.22	6.31	.013
Student (error)	135	17.32		

Table 13

Mean Scores by Treatment and District: Grade 3 Achievement Test[1]

	Mean	
District	No Instruction	Instruction
A	25.71	34.32
C	30.02	34.66
Combined	28.97	34.55

[1] possible score = 43

Grade 5. Table 14 presents results of Analysis I for grade five, displaying significant effects for pre- vs. post-test scores -- gain attributable to treatment -- for overall performance by district, and for a District-by-gain interaction. Overall, grade five students achieved higher scores on the posttest than they had on the pretest; overall district means differed significantly; and the magnitude of the achievement gain differed significantly among districts.

Table 15 presents mean pre- and posttest scores by district, demonstrating the nature of the significant gains displayed in Table 14. At pretesting, District B students achieved a mean score appreciably lower than students in Districts A and C. At posttesting, however, the difference is slight; students in District B had nearly made up their deficit. Clearly, students in all districts improved their scores following Project Learning Tree instruction: the overall mean score went up more than 25 percent. While gains in Districts A and C were similar, a greater change occurred in District B; there the main score improved more than 40 percent. Figure 3 provides a graphic representation of these results.

Table 14

Summary Analysis of Variance Table for Pre vs Posttest and District Effects: Grade 5 Achievement Test, Analysis I

Source	df	Mean Square	F	p
District	2	616.16	8.60	<.001
Student (within district)	163	71.65		
PRE VS POSTTEST (gains)	1	7262.81	390.85	<.001
District X Gain	2	193.84	10.43	<.001
Student X Gain	163	18.58		

Table 15

Mean Pre and Posttest Performance by District: Grade 5 Achievement Test[1]

District	Mean	
	Pretest	Posttest
A	34.76	43.55
B	28.40	41.10
C	35.53	42.86
Combined	33.49	42.63

[1] possible score = 59

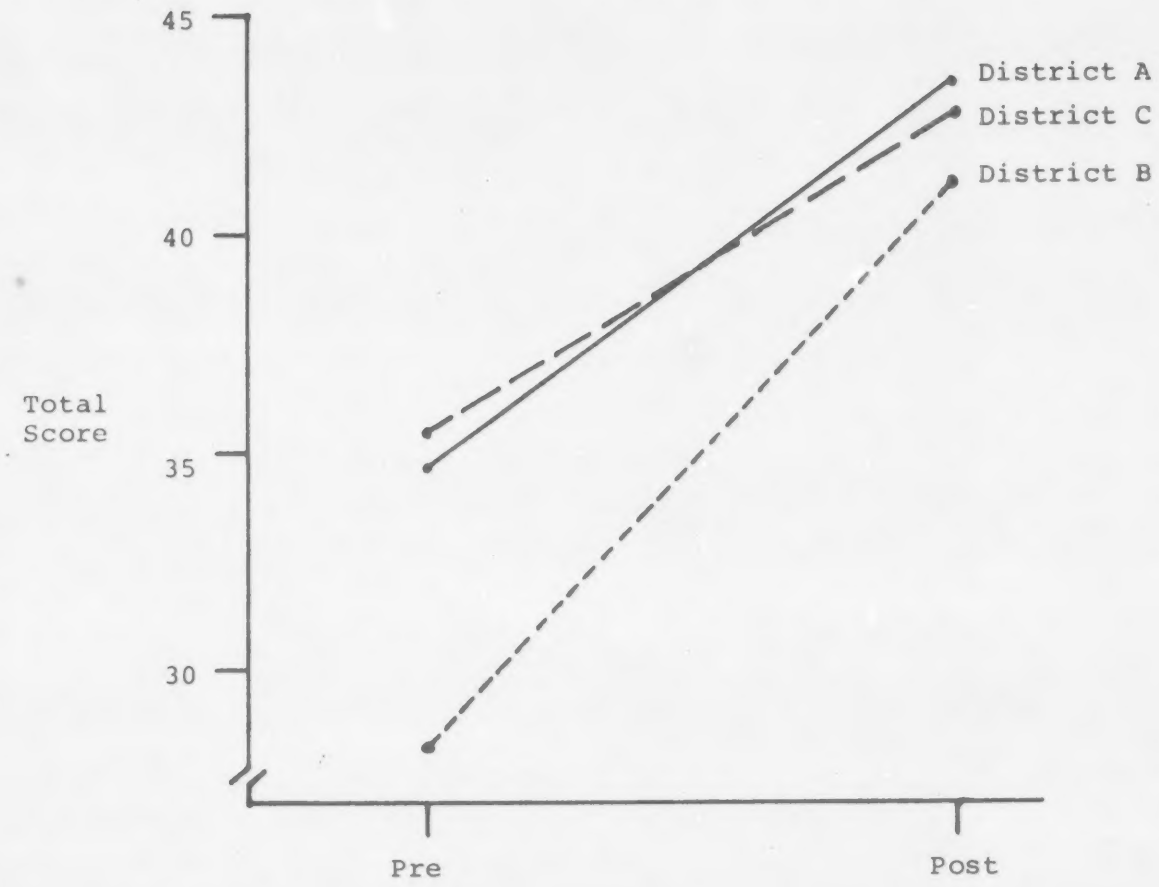


Figure 3. District differences in Grade 5 Achievement Test Gains.

When the performance of students who had completed the Project Learning Tree unit was compared with that of students who had not (Analysis II), a similar pattern appeared. Unfortunately, posttest data for this group of District B students was not available; these analyses are restricted to Districts A and C, and the strong District B treatment effect described above could not be examined further. As indicated in Table 16, a significant main effect for instruction was evident. While no overall effect for district appeared, there was again a significant treatment-by-district interaction.

Examination of Table 17 reveals that, in this case, the significant interaction between instruction and district is due to a greater effect of instruction in District A than in District C.

Table 16

Summary Analysis of Variance Table for Treatment and District Effects: Grade 5 Achievement Test, Analysis II

Source	df	Mean Square	F	p
Instruction	1	2247.40	48.72	<.001
District	1	70.22	1.52	ns
Instruction X District	1	194.78	4.22	.041
Student (error)	216	46.13		

Table 17

Mean Scores by Treatment and District: Grade 5 Achievement Test[1]

District[2]	Mean	
	No Instruction	Instruction
A	34.76	43.23
C	35.53	40.15
combined	35.21	41.95

[1] possible score = 59

[2] Administrative problems in District B restricted this analysis to Districts A and C.

Grade 7. Because of administrative anomalies in implementing the experimental design in two districts, analysis of grade seven achievement results was restricted to repeated measures (pre- vs. post-) analysis of variance. These results are presented in Table 18. As at grades three and five, a significant main effect for gains emerged, as did a significant District-by-gain interaction: here again, the magnitude of gain differed from one district to another.

Mean pre- and posttest scores by district appear in Table 19. At pretesting, the mean scores are equivalent across districts. At posttesting, however, District B is seen to have experienced larger gains than have Districts A and C. This interaction is represented graphically in Figure 4.

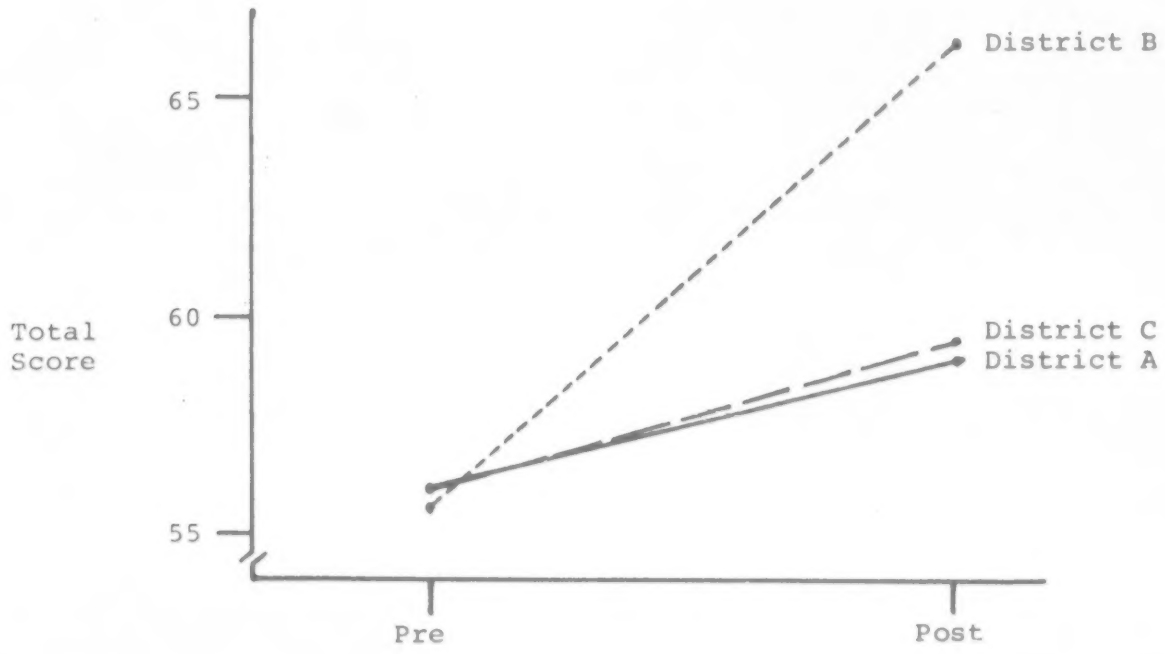


Figure 4. District differences in Grade 7 Achievement Test Gains.

Table 18

Summary Analysis of Variance Table for Pre vs Posttest and District Effects: Grade 7 Achievement Test

Source	df	Mean Square	F	p
District	2	200.15	2.39	ns
Student(within district)	149	83.58		
PRE VS POSTTEST (Gains)	1	1725.34	84.11	<.001
District X Gain	2	225.19	10.98	<.001
Student X Gain	149	20.51		

Table 19

Mean Pre- and Posttest Performance by District: Grade 7 Achievement Test[1]

	Mean	
District	Pretest	Posttest
A	56.06	59.08
B	55.84	66.37
C	56.05	59.41
Combined	56.03	60.13

[1] possible score = 83

Performance on affective scales

Repeated measures analyses of variance were executed to examine changes in affective scores attributable to Project Learning Tree instruction. At each of grades three and five, analyses are based on results from Districts A and C.

The waitlist-control group design called for all students -- both Design Groups A and B -- to write the affective tests at time 1, initiation of the experiment. Group A then received Project Learning Tree instruction, while Group B was "waitlisted". At time 2, both groups again completed the affective scales. For Group A, then, this administration served as a posttest. Effects of Project Learning Tree instruction were assessed by comparing the time 1 to time 2 results for Group A -- the experimental group at this point -- with those for Group B -- the waitlist controls for the affective scales.

The sources of variance in the summary tables in this section are:

1. Design Group: differences between students assigned to Group A and those assigned to B. This term combines performance at time 1 with time 2, and is not logically interpretable as an effect.

2. District: differences between students in different districts.

3. Design Group by District: differences among Design Groups in different districts (for example, between Group A in District A and Group A in District C).

4. Student (within group and district): a residual or error term.

5. Time of testing: differences between time 1 and time 2 when both Groups A and B are considered. This term provides an indication of the effect of writing the tests a second time, regardless of whether Project Learning Tree instruction had occurred.

6. Instruction (Time by Group): differences between changes in Group A scores from time 1 to time 2 and Group B scores from time 1 to time 2. A significant difference indicates that Project Learning Tree instruction has affected performance.

7. Time by District: differences between time 1 and time 2 scores in all students in one district, with those in another district.

8. Instruction by District: differences in changes in Group A scores from time 1 to time 2, and Group B scores from time 1 to time 2 between one district and another. A significant difference indicates that Project Learning Tree instruction has had a greater effect in one district than in the other district.

At grade seven, it was not possible to examine District effects because of anomalies in field implementation described earlier.

Grade 3. Results of the analyses of the grade three affective scale -- Trees and Logging -- are summarized in Tables 20 through 22.

As indicated in Table 20, no significant effects for instruction or instruction-by-district were demonstrated for Attitude toward Logging. Overall, students in Design Group A displayed significantly different scores than those in Group B, and students in one district differed from those in the other district. Neither Instruction nor Instruction-by-District were significant: that is, students' attitudes toward logging did not become more favourable following the Project Learning Tree unit. The means presented in Table 20 illustrate this result: overall, students in District A demonstrate less positive attitudes toward logging than those in District C. This result was not surprising; District C is in a community which is economically dependent upon forest-related industries. There is very little difference within each district, however, between scores of students who received Project Learning Tree instruction and those who did not.

Analysis of the attitude toward trees scale is summarized in Table 21. Differences attributable to group assignment, district, group within district and time of testing are significant. Again, no main effect for instruction is evident: over all districts, responses of students who received Project Learning Tree instruction

Table 20

Summary Analysis of Variance Table for Treatment and District Effects: Grade 3 Affective Scale: Logging

Source	df	Mean Square	F	p
Design Group (A vs B)	1	412.34	11.35	.001
District	1	710.95	19.58	.001
Group X District	1	63.39	1.75	--
Student (within group & district)	135	36.31	--	--
Time (of testing)	1	6.97	0.60	--
INSTRUCTION (time x group)	1	25.18	2.16	--
Time X District	1	10.28	0.88	--
INSTRUCTION X District	1	0.26	0.02	--
Student (error)	135	11.64	--	--

Table 21

Summary Analysis of Variance Table for Treatment and District Effects: Grade 3 Affective Scale: Trees

Source	df	Mean Square	F	p
Design Group (A vs B)	1	4539.48	25.87	.001
District	1	5666.98	32.30	.001
Group X District	1	9532.83	54.33	.001
Student (within group & district)	135	175.46	--	--
Time (of testing)	1	738.94	20.15	.001
INSTRUCTION (time x group)	1	4.50	0.12	--
Time X District	1	120.23	3.28	--
INSTRUCTION X District	1	289.87	7.90	.006
Student (error)	135	36.68	--	--

Table 22

Mean Scores by Treatment and District:
Grade 3 Affective Scales for Logging and Trees.

Scale	District	Mean	
		No Instruction	Instruction
Logging[1]	A	24.82	28.55
	C	21.81	24.26
Trees[2]	A	54.94	30.59
	C	55.70	54.64

[1] Low scores indicate a positive attitude; possible range is 0 to 35.

[2] Low scores indicate a positive attitude; possible range is 23 to 115.

were equivalent to those of students who did not. For this scale, however, a significant Instruction-by-District interaction is indicated. Examination of the means displayed in Table 22 reveals the nature of this interaction: students in District A who received Project Learning Tree instruction had much more positive attitudes toward trees than those who had not received Project Learning Tree lessons; in District C, however, no such difference appears. This interaction is represented graphically in Figure 5.

Grade 5. Grade five results for the affective scales are summarized in Tables 23 through 25. These results, based on the same affective scales as were used at grade three, display the same pattern.

Table 23, which summarizes the analysis of variance for Attitude toward Logging, indicates that no significant effects are associated with Project Learning Tree instruction. There are significant differences between Groups, between Districts, and by Group within District. The means displayed in Table 25 illustrate the consistency of scores, regardless of instruction. As at grade three, District C students indicated more positive attitudes toward logging than did their counterparts in District A. No effect for instruction versus no instruction appears, although following Project Learning Tree instruction, attitudes evoked by pictures of logging activities were slightly more negative.

Table 23

Summary Analysis of Variance Table for Treatment and District Effects: Grade 5 Affective Scale: Logging

Source	df	Mean Square	F	p
Group (A vs B)	1	644.60	17.29	.001
District	1	616.08	16.52	.001
Group X District	1	206.03	5.52	.019
Student (within group/district)	203	37.29		
Time (of testing)	1	8.78	1.03	ns
INSTRUCTION (time x group)	1	4.78	0.56	ns
Time X District	1	2.75	0.32	ns
INSTRUCTION X District	1	11.90	1.40	ns
Student (error)	203	8.50		

Table 24

Summary Analysis of Variance Table for Treatment and District Effects: Grade 5 Affective Scale: Trees

Source	df	Mean Square	F	p
Group (A vs B)	1	1542.35	6.74	.010
District	1	288.40	1.26	ns
Group X District	1	886.17	3.87	.050
Student (within group/district)	203	228.75		
Time (of testing)	1	1161.97	22.98	.001
INSTRUCTION (time x group)	1	1021.00	20.19	.001
Time X District	1	895.36	17.71	.001
INSTRUCTION X District	1	482.68	9.55	.002
Student (error)	203	50.56		

Table 25

Mean Scores by Treatment and District:
Grade 5 Affective Scales for Logging and Trees.

Scale	District	Mean	
		No Instruction	Instruction
Logging[1]	A	24.51	25.16
	C	20.03	23.92
Trees[2]	A	58.51	45.04
	C	56.41	55.03

[1] Low scores indicate positive attitude; possible range = 7 to 35.

[2] Low scores indicate positive attitude; possibel range = 23 to 115.

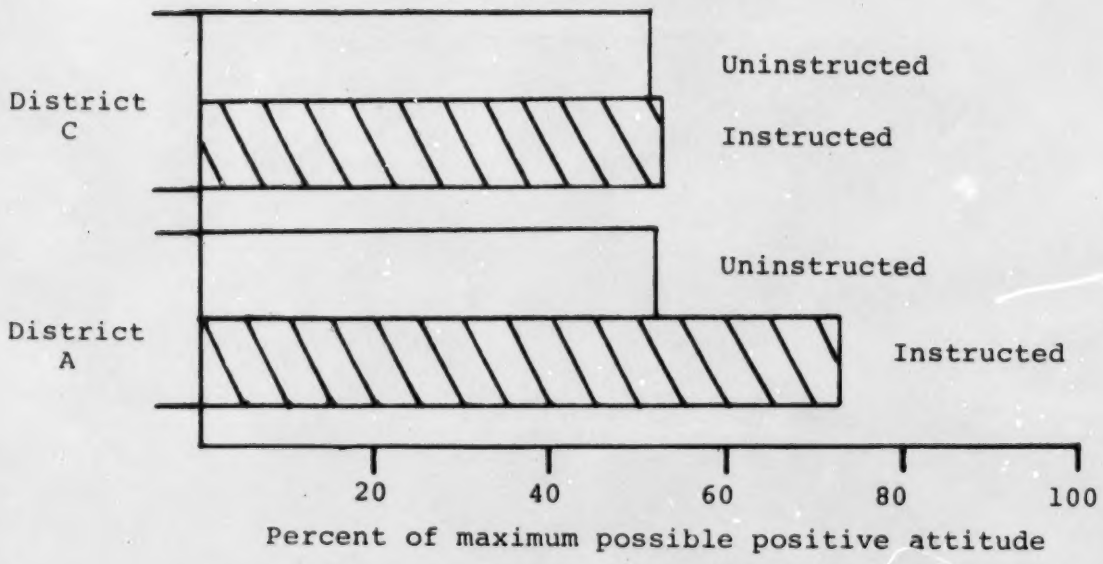


Figure 5. District differences in effects of PLT instruction on Attitude toward Tree: Grade 3.

Table 24 presents results for the Attitude toward Trees scale. For this scale, no district effects appear, but there are significant effects both for instruction and for instruction-by-district. The means presented in Table 25 indicate the nature of these effects: student response to the pictures of trees is much more positive following Project Learning Tree instruction in District A; the difference is so great, in fact, that although there is no apparent difference in District C, there was a main effect for Project Learning Tree instruction. The interaction of instruction-by-district is presented graphically in Figure 6.

Grade 7. The four subscales of the affective measure used at grade seven were analyzed separately. Results of these analyses are presented in Tables 26 through 31.

Table 26 presents mean scores for each scale by instruction versus no instruction; high scores are associated with positive attitudes. Examination of the means for the no instruction condition indicates strong student support for the Extreme Conservation and the Responsible Development positions, mild disagreement with the Moderate Conservation position and extreme disagreement with the Irresponsible Development position. Students who were exposed to the Project Learning Tree unit demonstrated increased support for Responsible Development, a slight negative

Table 26

Mean Scores by Instructional Condition:
Grade 7 Affective Scales

Scale[1]	Mean	
	No Instruction	Instruction
Extreme Conservation	17.10	16.30
Moderate Conservation	13.44	12.85
Responsible Development	18.11	16.32
Irresponsible Development	23.82	22.88

[1] for the subscales, high scores are associated with negative attitudes. The possible range of scores for each subscale is 7 to 28.

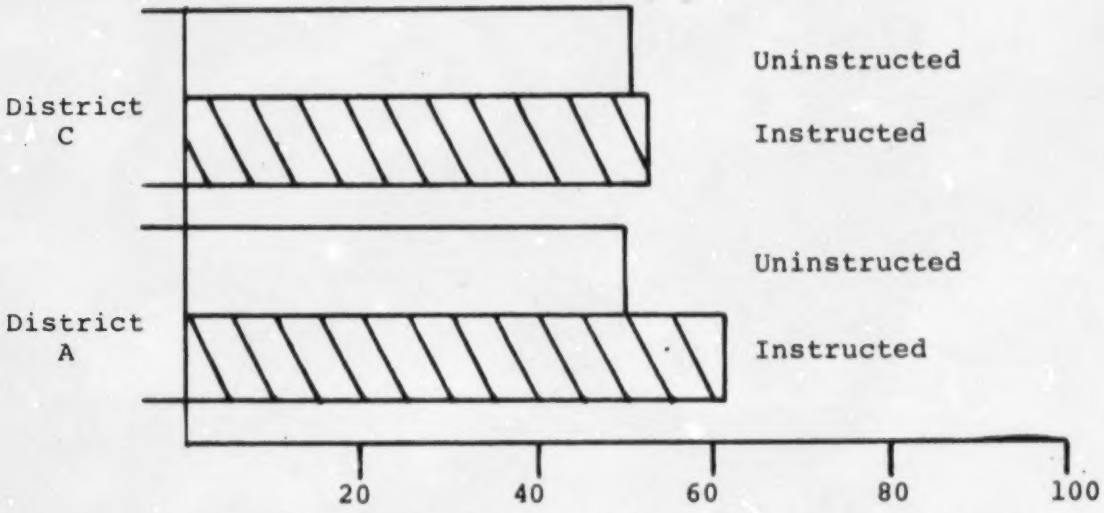


Figure 6. District differences in effects of PLT instruction on Attitude toward Tree: Grade 5.

shift in support for the conservation positions -- although support for Extreme Conservation remains strong -- and a slight moderating of the extreme disagreement with Irresponsible Development -- although this position remains the least favoured of the four.

Table 27 summarizes results of the inferential analysis for the Extreme Conservation position. No significant effects are demonstrated: student scores did not differ by group assignment, by time of testing, or by Project Learning Tree instruction versus no instruction. As noted above, strong support for this position was evident throughout the study; it did not seem modifiable by means of the instruction presented.

Results of analysis for the Moderate Conservation scale are summarized in Table 28. Again, no significant differences are attributable to group assignment or to Project Learning Tree instruction. A significant effect does appear for time of testing: that is, student scores showed a slight decrease from the first testing period to the second, whether or not they had been exposed to the Project Learning Tree units.

Table 29, which summarized results for Moderate Development, displays two significant effects: student scores varied according to group assignment, and were affected by Project Learning Tree instruction. Referring back to the means in Table 26 , it is

Table 27

Summary Analysis of Variance Table: Grade 7
Affective Scale for Extreme Conservation

Source	df	Mean Square	F	p
Design Group (A vs B)	1	56.20	2.59	ns
Students (within group)	93	21.68		
Time (of testing)	1	0.06	0.02	ns
INSTRUCTION (group x time)	1	0.39	0.11	ns
Students (error)	93	3.59		

Table 28

Summary Analysis of Variance Table: Grade 7
Affective Scale for Moderate Conservation

Source	df	Mean Square	F	p
Design Group (A vs B)	1	0.04	0.00	ns
Students (within group)	93	12.00		
Time (of testing)	1	16.81	6.93	.010
INSTRUCTION (group x time)	1	0.98	0.40	ns
Students (error)	93			

Table 29

Summary Analysis of Variance Table: Grade 7
Affective Scale for Moderate Development

Source	df	Mean Square	F	p
Design Group (A vs B)	1	10.46	0.93	ns
Students (within group)	93	11.22		
Time (of testing)	1	8.76	4.75	.032
INSTRUCTION (group x time)	1	4.38	2.38	ns
Students (error)	93	1.84		

Table 30

Summary Analysis of Variance Table: Grade 7
Affective Scale for Irresponsible Development

Source	df	Mean Square	F	p
Design Group (A vs B)	1	10.46	0.93	ns
Students (within group)	93	11.22		
Time (of testing)	1	8.76	4.75	.032
INSTRUCTION (group x time)	1	4.38	2.38	ns
Students (error)	93	1.84		

apparent that students who were exposed to the Project Learning Tree unit demonstrated significantly greater support for moderate development than those who were not.

Table 30 shows no such instructional effect for attitude toward the Extreme Development position. Students who had received Project Learning Tree instruction maintained the negative attitude toward this position which was displayed by students who had not received instruction. There is, however, a significant effect for time of testing; that is, although instruction did not appear to alter support for this position, responding to the same questions a second time did -- a reactivity effect.

A final analysis examined effects of group, time of testing and instruction on a total score obtained by reversing polarities of two scales and applying a system of weighting such that high scores indicated support for Development as opposed to Conservation. The mean score for students who had not received instruction -- 86.89 -- was only slightly lower than that of students exposed to the Project Learning Tree unit -- 87.76. Table 31 summarized inferential analysis of this data, and indicates no significant effects for group assignment, time of testing or instruction. This is not inconsistent with the findings that instructional effects are limited to moderate "positions" and that endorsements of extreme positions were not altered by this treatment

Table 31

Summary Analysis of Variance Table:
Grade 7 Affective Scale: Total Score

Source	df	Mean Square	F	p
Group (A vs B)	1	1.97	0.01	--
Students (within group)	93	267.30		
Time (of testing)	1	19.44	0.47	--
INSTRUCTION (group x time)	1	70.85	1.70	--
Students (error)	1	41.66		

Summary

Table 32 presents a summary of results of the inferential analyses for both achievement and affective measures at each grade level. For each of the three grades, student achievement test scores improved significantly between pre- and posttesting. The pattern of gains, however, was not consistent from one district to another: at each grade level, student performance showed significantly greater improvement in some districts than in others. Overall, students in District C demonstrated the strongest gains although where the experimental design was maintained in District B, extremely strong gains appeared. This result is consistent with the evaluation team's observation that only those District B teachers with a strong committment to environmental education were able to complete the experimental program.

Results of the affective instruments were less consistent. Neither grades three nor five students displayed a significant change in attitude toward logging activities. While grade five students overall showed a significant change in attitude toward trees, significant changes at grade three were restricted to only one of the districts; overall, student attitudes remained stable among students in these two grades.

At grade seven, students displayed no change in support for the conservation/recreation positions attributable to instruction. They did, however, demonstrate significantly greater support for the Responsible Development role following exposure to the Project Learning Tree unit, and slightly less disagreement with the Irresponsible Development role. It should be noted that, in spite of this increase, Irresponsible Development maintained its pretest position as the role evoking the most strongly negative reactions.

Table 32

Summary of Results: Inferential Analyses of Affective and Achievement Outcomes at ALL Grades

Grade	Test Type	Subtest	Main Effect Instruction	Interaction: Gain-by-District
3	Achievement	Total	SIGNIFICANT	SIGNIFICANT
	Affective	Logging	(not significant)	(not significant)
		Trees	(not significant)	SIGNIFICANT
5	Achievement	Total	SIGNIFICANT	SIGNIFICANT
	Affective	Logging	(not significant)	(not significant)
		Trees	SIGNIFICANT	SIGNIFICANT
7	Achievement	Total	SIGNIFICANT	SIGNIFICANT
	Affective	Extreme Cons.	(not significant)	
		Moderate Cons.	(not significant)	
		Respons. Devel.	SIGNIFICANT	
		Irresp. Devel.	SIGNIFICANT	

Selected subtest results: Achievement tests

At each grade level, individual item and subtest results for pre- and posttests were examined to determine areas where exposure to the Project Learning Tree units had had the greatest effect. These results were considered only for the total sample, and were not differentiated by district.

Grade 3. Student performance showed the greatest improvement on those items which related to "tree cookies" and to distinctions between coniferous and deciduous trees. For example, before Project Learning Tree instruction, only fifty-six percent of students correctly indicated the reason for variations in the width of annual rings; following instruction, eighty percent answered correctly. At pretesting, thirty-three percent identified the relationship between rings and growth patterns; at posttesting, sixty-one percent chose the correct answer; pre-instruction, sixty-six percent recognized that the number of rings indicates age; at posttesting, over ninety percent.

Changes were similar for those questions relating to the coniferous-deciduous distinction. Before instruction, thirty-one percent chose "coniferous" when asked to select "a tree that has needles for leaves". After the Project Learning Tree unit, seventy-eight percent chose the correct answer. While most students were able to identify correctly only one or two of the six pictures as relating to "coniferous", "deciduous" or "both" at pretesting, after they had received Project Learning Tree instruction, most scored four or five correct out of six.

For many of the items, student entry-level scores were so high as to preclude substantial gain: for example, almost all students were able to identify basic geometric shapes at pre-testing, to select things that would harm or benefit trees, and to identify basic tree parts.

As might be expected, students showed greatest gains in areas where pretest performance was weak: where the unit introduced new information or skills, students were able to assimilate these.

Grade 5. Grade five subtest and item level results displayed a more consistent pattern of gains than those for grade three. Total test scores were more than twenty-five percent higher following Project Learning Tree instruction than pre-instruction; gains were apparent on most items.

Following instruction, grade five students showed particularly strong improvement in:

- identifying recreational equipment made from forest products,
- forecasting both positive and negative consequences of development,
- understanding patterns of natural succession,
- estimating use of paper products in the classroom,
- relating annual rings to growth and age patterns, and
- interpreting graphic representations of plant growth.

At posttesting, questions relating to these activities were typically answered correctly by more than eighty percent of students.

Grade 7. In absolute terms, the magnitude of overall gains attributable to instruction was not as large as that found at grade five; at grade seven, the mean difference between the percent of students responding correctly at posttesting compared to pretesting was approximately eight percent. This change was distributed relatively evenly over items with students showing increased ability to:

- distinguish between renewable and nonrenewable resources,
- predict both positive and negative consequences of development activities,
- suggest ways in which living trees have value,
- recognize that paper products can be recycled,
- identify measures used in the B.C. forest industry, and
- define terms such as 'watershed'.

Evaluation by the teachers

Teacher evaluation forms (see Appendix F) which permitted anonymity were mailed to each participant. Information about the school and teacher was solicited, along with lesson and unit evaluations and participation records.

Grade three respondents reported from one to sixteen years' teaching experience; all indicated language arts as the content area of greatest interest, although two also specified science. Most teachers indicated that all twelve lessons had been used as designed in the unit provided, although some modifications -- and in one case omission -- of Lesson 9, "Build your favourite tree", and Lesson 10, "Expanding sensory perception" were described. Modifications to the lessons were all in the form of extensions, through developing supplementary drama or other activities.

On a five-point rating scale, most of the lessons received ratings of "4" ("good"), and only one rating of less than "3" ("satisfactory") appeared in all the questionnaires. Lessons 3 and 4, "Adopt-a-tree", and "How big is your tree?" received the highest ratings.

All respondents indicated that they intended to use the units again, and all rated overall aspects of the unit -- organization, suitability, student response, presentation, content and practicality -- as satisfactory or better. Grade three teachers appeared

to be particularly impressed with the suitability of the materials for the grade level. The only suggestion offered was that more extensive background material be provided for the teachers.

Grade five respondents generally reported more experience -- 6 to 30 years -- and a greater diversity of curriculum interests, often including science. Although most teachers indicated that they had completed the twelve lessons, greater frequency of both omissions and modifications was noted. Three teachers omitted Lesson 12, "Outdoor manners colouring book", and one had also omitted Lesson 10, "Maple mallets and ash bats". Modifications most often appeared to have been dictated by time or space constraints. For Lesson 1, for example, one teacher noted that she taught ninety-seven students, and her classroom space simply would not accommodate ninety-seven plants; so instead six plants were started for each of the three classes. Other teachers had modified Lesson 1 by having students independently collect soil samples from near their homes.

Teacher ratings of the individual lessons, although generally falling at "satisfactory" or better, also displayed somewhat more variability than those for grade three. Lesson 4, "Sunlight and shades of green", received a rating of "poor" from one teacher, who commented that somewhat unseasonal gloom had caused the experiment to fail because there was no sunlight. The greatest range of responses -- from "fair" to "excellent"-- appeared for Lesson 3,

"Tree cookies". Lessons 1, 6 and 11 -- "What's in soil", "The closer you look", and "Paper in the classroom/Classroom conservation" -- received the highest overall ratings.

All respondents indicated plans to use the grade five unit again. For the most part, teachers rated overall aspects of the unit "good", although one teacher felt the organization was weak, noting problems with time and resources. While the number of respondents reporting different subject area interests was too small to justify statistical analyses, perusal of the responses of the grade five teachers indicated clearly that teachers who indicated science as one of their major subject area interests were generally more positive in their reactions to the Project Learning Tree unit than those who indicated other -- for example, music -- areas of primary interest.

The major criticism offered by the grade five teachers was objection to the rigidity of the experimental timetable. The following comment may be considered typical of this group of respondents, and thus is offered as a summary:

> I found this unit to be very interesting and challenging. Students were enthused and participated well. The main criticism that I have is that the unit should have been started about a month earlier; then there would have been more time for expanding activities. However, I consider this to be a worthwhile unit which should be included in our course of studies.

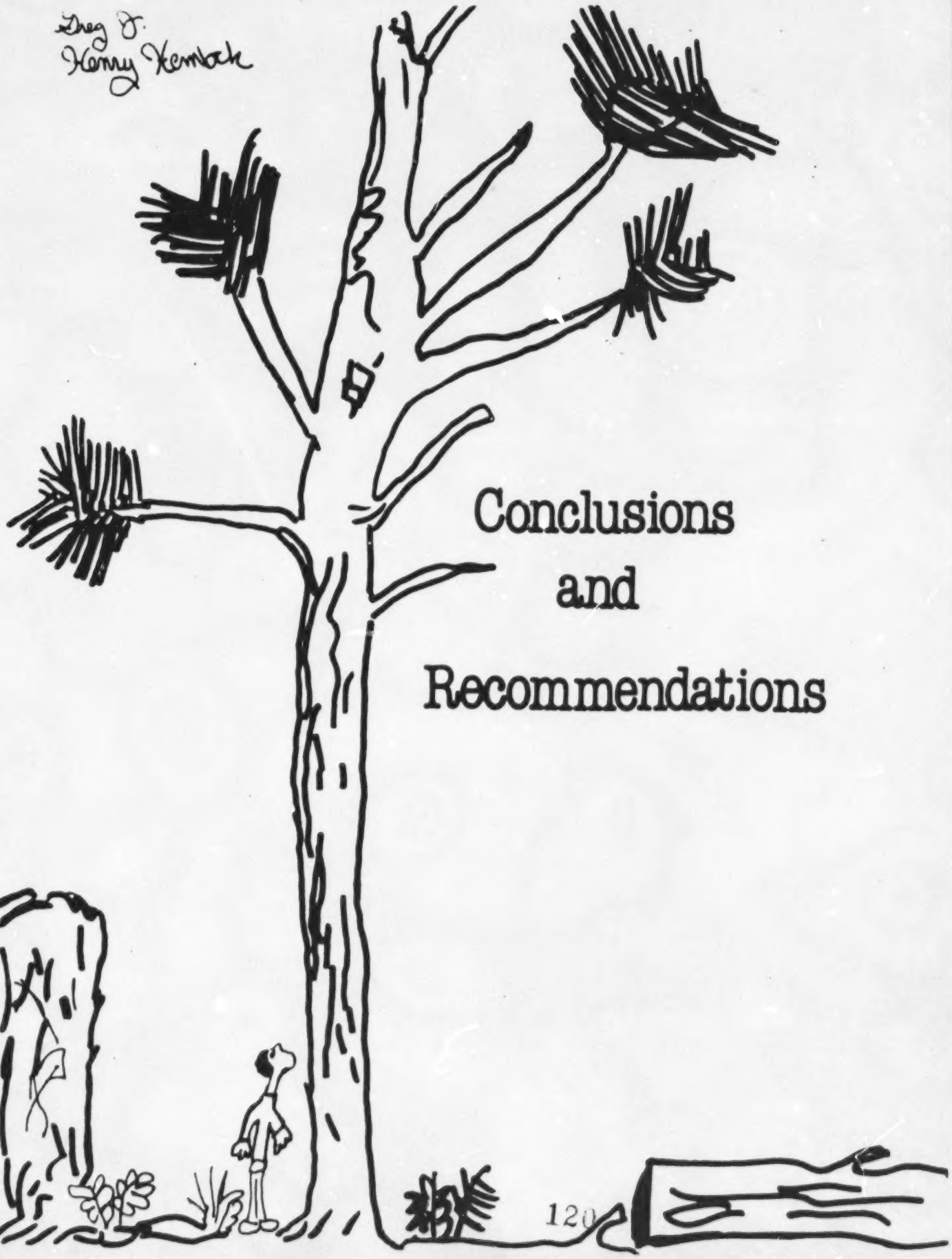
Grade seven teachers reported a range of experience -- five to twenty years -- and curriculum interests similar to the grade five teachers.

Severe time pressure was reported by a number of grade seven teachers who frequently reported omitting one or more lessons -- most often Lessons 11 through 14. These omissions were particularly evident for Treatment B, District 3. Lessons were frequently modified -- for example, Lesson 1 was often abbreviated to eliminate some of the more complex calculations. One teacher substituted materials and activities (see Appendix D) for Lessons 9 to 11, with students compiling issues, presenting speeches, holding all candidates' meetings and elections, and debating issues at mock council meetings. Lessons 3 and 4, "Classifying forest products for compatability" and "With or without", received the highest ratings -- "good" or "excellent" -- from the total group of respondents. Those teachers who were able to complete them rated Lessons 11 and 12, "Official visit" and "My use or your use" as "excellent".

Generally, grade seven teachers were more critical of the Project Learning Tree materials than their counterparts at grades three and five. All but one -- who responded "maybe" -- indicated intentions to use the materials again. One teacher suggested that Project Learning Tree was in need of a major overhaul, commenting that "the ideas are good, but more content to back them up is

required". Teachers from District 3 -- an area largely dependent on forest industries -- were most positive about the materials. Ratings of overall aspects of the unit were consistently set at "satisfactory" or better, although one teacher rated practicality of the lessons "fair", citing a lack of support materials and time.

Grade seven teachers' responses indicate that delivery of the unit was much more idiosyncratic at grade seven that at grades three and five. Consequently, results for grade seven students should be interpreted with caution.



Conclusions and Recommendations

CONCLUSIONS AND RECOMMENDATIONS

Completion of Phase I of the evaluation (the Phase I report appears as Appendix G) demonstrated that Project Learning Tree enjoys wide distribution in British Columbia. Both the workshops and the materials are well-received by teachers and administrators, and the issues implicit in Project Learning Tree are topical in B.C., a province with deep concern for management and preservation of natural resources. At the same time, however, classroom use of Project Learning Tree is idiosyncratic, and less widespread than might be inferred from the apparent success of the workshops.

The unit development activities at the initiation of Phase II demonstrated the ease and cost efficiency with which segments of Project Learning Tree can be packaged into units for systematic use at various grade levels. The strength and variety of the materials, and the flexibility of the manuals, were readily apparent.

The achievement tests, based on specific objectives within each unit, appear to have provided valid and reliable information about students' cognitive gains through Project Learning Tree instruction, and are suitable for further use with the units developed in this study. The demonstrated success of these scales in providing reliable estimates of attitude and attitude changes suggest that the techniques used may have broad application in assessing the efficacy of Project Learning Tree instruction in a variety of contexts. They could be used with any of the PLT lessons.

Where a set of Project Learning Tree lessons are presented systematically, it is clear that cognitive gains and affective changes ensue. At grade seven, the unit on resource use resulted in significant changes -- increasingly positive -- in attitudes toward responsible development. At grades three and five, students exposed to units about the nature and uses of trees demonstrated more positive attitudes towards trees than those who had not received Project Learning Tree instruction.

The packaging of instructional units and resource materials appeared to be the most effective way of ensuring classroom delivery of Project Learning Tree lessons. Teachers provided with a systematically designed unit of instruction, together with all of the resources required by the unit, made extensive use of Project Learning Tree in their classrooms. Competing demands for instructional time -- particularly at grade seven -- appeared to form the greatest barrier to Project Learning Tree use.

In the upper elementary grades, many teachers find it difficult to cover all of the mandated curricula; activities viewed as optional -- even where these are 'approved' by the Ministry of Education -- tend to be included only where they converge with the teacher's strong enthusiasm. At grade seven, then, teachers with strong personal commitment to resource and outdoor education tended to complete the Project Learning Tree units, while those without prior interest, often were unable to include all of the activities.

Recommendations

The following recommendations are based on results of the Phase I survey, the Phase II field experiment, and discussions with Project Learning Tree participants and facilitators. Regarding Project Learning Tree materials, we recommend that:

> Efforts be directed to the development of "units" of Project Learning Tree lessons suitable for use at various grade levels in British Columbia.
>
> These units be focused on (1) topics for which Project Learning Tree is specified in the B.C. curriculum guides as an approved resource, and (2) primary and early intermediate grades.
>
> Teachers' guides containing extensive background materials be developed to accompany these units.
>
> The resource "kits" be made available to accompany such units.

The flexibility of the manuals is a principal strength of Project Learning Tree; it allows for use in a variety of geographic, curricular and grade level contexts, permitting teachers to tailor instruction to fit the needs of their particular classes. At the same time, however, this flexibility creates a barrier to use: teachers, besieged by competing demands on their preparation time, are often more likely to use materials which appear as intact units, than materials which require organization, structuring and further preparation. Teachers who participated in the field experiment -- all of whom had demonstrated interest in Project Learning Tree by

volunteering -- often made their participation conditional: they would be pleased to take part as long as they were provided with (1) intact sequenced instructional units, (2) training in delivery of the units, (3) any background information required, and (4) packages of all resource materials -- such as tree cookies, seeds, aromatic woods -- required to complete the lessons. There is no reason to believe that these conditions are atypical requirements of classroom teachers. As many of the experimental teachers pointed out, most elementary teachers typically prepare lessons for more than seven curriculum areas each day. Regardless of their level of interest, they are more likely to use materials which are on hand and require little further organization.

Where Project Learning Tree is specified as approved for a topic in the provincial curricula, availability of a sequenced unit seems likely to enhance the probability that Project Learning Tree will be selected over other alternatives. As well, because science and social studies curricula are most flexible in the early elementary grades, units directed at these grades seem to enjoy a higher rate of use than those directed at older students.

Many of the teachers involved in the experiment expressed a desire for more background information to accompany the units. They pointed out that those whose major training and responsibility lay in areas such as reading or music, required a great deal of information in order to feel comfortable with the PLT lessons.

Regarding the resource packages, it appears that if initiative for obtaining materials is left to individual teachers, the resources are not acquired. More aggressive distribution of the resources currently available seems warranted, perhaps through local Canadian Forestry Association contacts. Rather, then, than responding to requests, the Canadian Forestry Association might take the initiative in offering to distribute such materials.

Regarding the workshops, the evaluation team recommends that:

> Current dissemination of Project Learning Tree, through workshops, be maintained.
>
> Introductory Project Learning Tree workshops be structured to include distribution of specific instructional packages and and materials appropriate for use by the participants.
>
> Follow-up of the workshop participants through mail contacts such as the newsletter be continued and intensified.

The Canadian Forestry Association has been successful in bringing Project Learning Tree to the attention of B.C. educators. At the time of the mail survey conducted as part of Phase I, close to 2000 individuals had attended workshops provided by the facilitator. As described in the Phase I report, the workshops are well-structured and engaging. The mail and telephone surveys indicated that participants were virtually unanimous in their strong positive reaction to the workshop experience. These surveys also indicated, however, that most participants had used in their own classrooms only those Project Learning Tree activities carried out as part of the workshop they happened to have attended.

This implies that systematic units of instruction -- differentiated by grade level -- introduced during the workshops would enjoy extensive classroom use. Rather than executing one or two Project Learning Tree activities in their classrooms, teachers would be likely to use an entire unit. At the same time, continued contact with those who attend workshops should be maintained. Again, providing teachers with specific, complete classroom activities which could be immediately and directly applied -- for example, camera-ready activity sheets or graphic materials -- seems likely to increase use of Project Learning Tree.

Regarding local activities, the evaluation team recommends that

> Efforts be made to identify educators in various regions of the province who have used the Project Learning Tree materials and are enthusiastic proponents of their dissemination.
>
> Local development of instructional units be strongly encouraged, and Canadian Forestry Association resources be made available to support such efforts.

The Phase I survey and the Phase II unit development workshops clearly indicated that teachers' initial response to Project Learning Tree is a positive one, and that a core of individual teachers and other educators are active and enthusiastic users of Project Learning Tree. This group of keen Project Learning Tree users is an untapped resource which, if developed, could enhance the dissemination of materials and the extent of Project Learning Tree use throughout the province. The Project Learning Tree facilitators are already aware

of many of these potential Project Learning Tree leaders. With some organization and encouragement, we believe these individuals could fulfill a number of vital roles in promoting and facilitating Project Learning Tree use in their local districts. One way of 'mobilizing' this resource would be an invitational workshop -- perhaps at one of the Outdoor Education Camps -- designed specifically for educators with demonstrated committment to Project Learning Tree as an instructional resource in B.C. Such a workshop might focus on the sharing of experiences and materials, the development of new materials or instructional units, and on strategies for increasing Project Learning Tree use at the local district level. Such a group would be invaluable to the Project Learning Tree facilitators as a sounding board or unofficial advisory group. The cost of such an undertaking need not be great. Our experience with the teachers invited to Vancouver to assist in developing units for this experiment was that they were keen to participate and expected only to have their out-of-pocket expenses reimbursed. They were anxious to further the use of Project Learning Tree, extremely task-directed, and willing to expend their personal time in Project Learning Tree development activities.

Where such individuals can be identified, they could initiate and contribute to development activities within their schools or districts. British Columbia is a large province encompassing great diversity across communities. Instructional units suitable for and appealing to students in urban areas may be inappropriate for students in rural areas; students in communities economically dependent

upon primary resource activities such as logging or mining may profit from lessons which have little relevance in industrial centres. Many of the Project Learning Tree lessons require investigation and discussion of local resources and resource use. The organization and amplification of these activities to relate specifically to an area would, we believe, increase the relevance and utility of Project Learning Tree on a local basis.

Regarding curriculum adoption, the evaluation team recommends that:

> The Canadian Forestry Association continue to work toward inclusion of selected Project Learning Tree materials as required in the B.C. Science and Social Studies Curricula.

In the upper elementary and the secondary grades, Project Learning Tree seems unlikely to enjoy extensive use unless it is offered as part of a required curriculum. It should be borne in mind that such adoption would imply distribution and implementation of the materials through the Ministry of Education. Under such circumstances, it would be necessary for the Canadian Forestry Association to augment its role in the dissemination of Project Learning Tree, and accept a lesser degree of control over delivery, especially in secondary stages. The ramifications of this ought to be recognized and deliberated upon before urging Project Learning Tree adoption in B.C. schools.

Regarding further research, and in view of the differential student gains demonstrated between school districts, we recommend that:

> Attention be directed to the identification of those sites or school districts where the introduction of Project Learning Tree will be most efficacious.

The results of Phase II indicate clearly that cognitive gains and changes in attitude resulting from Project Learning Tree instruction are not consistent from one location to another. In some districts, student gains were impressive; in others, marginal. Further research should address the question, "What pre-existing regional or local conditions or characteristics are associated with maximal instructional effects?" The answer to this question would enable the focusing of dissemination and training efforts to those locals where the greatest gains might be expected, and, at the same time, would offer some insight into the processes which might enhance the readiness of a district for the installation of Project Learning Tree.